FINANCING RENEWABLE ENERGY

OPTIONS FOR DEVELOPING FINANCING INSTRUMENTS USING PUBLIC FUNDS

THE WORLD BANK

CLIMATE INVESTMENT FUNDS

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PREFACE

To create new economic opportunities, increase energy access, and reduce carbon emissions, the governments of many low-income countries have embarked on the path to low-carbon development. But because funding from public and concessional sources is scarce, an engaged private sector will be needed to make significant investments in renewable energy technologies (RETs). With an appropriate enabling framework, those investments should be forthcoming.

The development of appropriate financing instruments—using public and concessional resources such as those provided under the Scaling-up Renewable Energy Program (SREP)—is one way to address the barriers and risks that presently hold back private investment. Using public and concessional funds to mobilize private financing rather than to pay the underlying costs of RETS offers the twin advantages of being more sustainable and minimizing the possibility of crowding out the private sector.

This paper offers a framework for analyzing the types of financing instruments that are most appropriate for addressing prevalent barriers and risks. This is seen as particularly relevant in the context of international climate finance discussions. The experience to date has been that policy makers tend to go straight to the use of a particular financing instrument without necessarily analyzing which instrument would be most effective for a given set of conditions. The paper and the accompanying Web tool (known as REFINe and available at www.worldbank.org/energy/refine) will provide information in a structured manner to allow policy makers to make fully informed decisions.

Both the paper and the accompanying Web tool are designed for easy use. They focus on practicality and usability, rather than comprehensiveness, and are intended to be used more broadly than under the SREP alone. Associated case studies and reference lists will be updated and developed over time in the online version.

In selecting instruments, efficiency is key. Policy makers should aim to use instruments that deliver the greatest amount of private financing for the least amount of public funds (thus achieving maximum leverage). To do so, financing instruments need to be appropriate for addressing the specific barriers and risks specific to the RETs being planned.

Different RETs have different degrees of exposure to the various identified barriers and risks. Barriers are created by underdeveloped financial markets. Examples of barriers include lack of long-term loans, high financing costs, high transaction costs, and poorly capitalized developers.

Risks refer to the high risks and costs of RETs. They include cost competitiveness, technology risks, regulatory risks specific to making RETs competitive, and resource risks. The paper considers how well different financing instruments address different barriers and risks. The list of instruments covered includes grants, equity, debt, asset-backed classes, guarantees, and insurance as well as more targeted categories such as results-based financing, carbon financing, and small-scale project financing. Delivery mechanisms such as commercial financial intermediaries and funds are considered separately.

Evidence on the relationship between instruments and barriers/risks consists of 33 case studies, most provided by the World Bank, International Finance Corporation, African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, and the Inter-American Development Bank. Other case studies are expected to be added to the REFINe Web site over time to provide a growing and continually updated reference source.

It is important to remember that there is no simple link between barriers/risks and the appropriate financing instruments. More than one instrument could be suitable to address each barrier/risk, or a single instrument could address multiple barriers/risks. This paper and the Web tool use the case studies to suggest which types of instruments may be most appropriate for addressing particular barriers and risks, with the aim of attracting significant additional investment.

INTRODUCTION

OBJECTIVE

This paper assists policy makers in low-income countries (LICs) to develop and apply financing instruments (funded from public and concessionary sources) to scale up the deployment of renewable energy technologies (RETs). The paper has been prepared under the Scaling Up Renewable Energy Program (SREP) in Low Income Countries, one of the Climate Investment Funds (CIFs) administered jointly by the World Bank Group (WBG) and regional development banks. The findings here, however, are applicable more broadly than in the focus countries and areas of the SREP.

The aim of the SREP is to pilot and demonstrate the viability of low carbon development pathways using renewable energy. Such viability is based on creating new economic opportunities, increasing energy access, and reducing carbon emissions. The SREP funds will assist LICs toward transformational change to low carbon energy pathways using their renewable energy potential. Transformational change in this context refers to a significant and sustained scale-up of RET investment, delivering levels of RET capacity well above the business-as-usual baseline. Recognizing that the private sector has a significant role to play in promoting renewable energy, the SREP funds will be used in particular to help overcome barriers (especially risks holding back investors) to scale up investment.

APPROACH

This paper is intended to provide a short introductory guide to the use of public and concessionary funds to support the scaling up of investment in RET projects. It does not pretend to be a comprehensive guide to the individual instruments described or to the full range of infrastructure project or RET financing issues. There are numerous other publications covering these topics in depth, many of which are referenced in this paper or noted in the reference section for further reading.

Consistent with its purpose, this paper also does not consider construction and operating risks and barriers that are generic across technologies and that could be managed through, for example, standard practices such as warranties or turnkey contracting. It also does not consider in detail measures to improve legal and regulatory frameworks for RETs that are better addressed through technical assistance and capacity building, although some guidance on the need for enabling frameworks is provided.

The focus of this paper is on the scaling up of commercially proven technologies, without necessarily assuming these are currently deployed in the country under consideration. These technologies include those that harness photovoltaic (PV) solar, solar thermal, onshore and offshore wind, geothermal, and biomass power (through combustion, gasification, and digestion); small hydropower used for electricity generation is also included.

OVERVIEW

The first two chapters of this paper discuss why the choice of instruments is important and what risks and barriers the types of publicly funded instruments discussed can address. The second part, comprising chapters 3 and 4, discusses the range of available instruments, illustrated by various case studies. In the third part, chapter 5 discusses how to select the relevant instruments and gives a more complete listing of case studies demonstrating the application of the various instruments against identified risks and barriers. The fourth and last part, chapter 6, considers the wider framework within which these instruments are applied.

A list of the case studies contained in the paper is provided in appendix 1. Full write-ups of case studies as well as additional information on the financing instruments discussed can be accessed via www.worldbank.org/energy/refine. References and sources for further reading can also be found at this website.

1 Why the Choice of Financial Instruments Matters

Any decision to use public or concessional funds to support renewable energy technologies (RETs) represents a commitment of scarce public resources to fund investments. In principle, the private sector should be capable of funding such investments itself, given an appropriate enabling framework; indeed, the private sector does so in many countries.[1] In doing so, it increases the resources available to other activities that may be far less amenable to private funding, such as health care and social welfare.

Efficiency is therefore key to the selection of the appropriate financial instruments to support RET investments. The aim should be to use those instruments that deliver the greatest amount of private funding for the smallest amount of public funds (thus achieving the greatest leverage).

Publicly funded financial instruments should target the barriers or risks that are constraining or inhibiting private investment, rather than simply being used to fund RET projects in general. As well as being more efficient, this also reduces the risk of "crowding out" private investment. Under the assumption that public finance will generally be lower cost than private finance, there will always be a preference to use public funding even where a project would be more suitable for private financing. Consequently, private investors find themselves unable to finance attractive projects, which are instead funded from public resources that could be better deployed elsewhere.

The use of public funding for RET projects also creates inevitable market distortions. Most obviously, if these funds discriminate between particular technologies, locations, or developers then there will be a concentration on those projects that are most likely to attract public financing, even if these are not the most efficient option. If public funds are limited in the total amounts available, the number of projects to be funded, or the time period over which projects are funded, then rent-seeking opportunities will be created.[2]

Practical or legal constraints will rule out some instruments and favor others. But care must be taken to ensure that such constraints are real rather than politically convenient. For example, if contingent liabilities do not need to be reported or funded, then there is an incentive to use guarantees rather than provide direct financing in the form of debt or equity. The cost of these guarantees will only become obvious if and when they are called, while the costs of direct financing are immediate and known. But this does not necessarily mean that guarantees are the optimal or most efficient instrument to mobilize investment in RET projects.

Instruments must be chosen with a view to the capabilities of local agencies to manage them effectively and efficiently, and of local financial markets to understand and use them. Constraints are inevitably country specific and will require investigation before decisions

1 This paper does not consider the wider issues of the appropriate level of support for RET investments or the market failures that may lead to inadequate investments in RET projects.

2 Rents result from the difference between the price and cost of a resource. For example, if public funds reduce the costs of RET projects included in a quota but not those outside the quota, while the price paid for their output reflects the cost of those projects without public funds, then rents are created by the difference between the cost of projects receiving public funds and the price. In turn, developers will seek to have their projects included in the quota to capture these rents. Such rent-seeking behavior is largely a deadweight loss to the economy, as it consumes time and effort but does not generate any additional wealth (instead, it redistributes wealth in the form of rents among different developers).

are made on which instruments to use. Some further discussion on institutional constraints is provided in chapter 6.

It is also possible to use the selection of instruments to help create the incentives for stakeholders to perform in ways that improve the eventual outcome of the intervention. This is the basis for the use of results-based financing, as discussed later in this paper.

2 Identifying the Risks and Barriers

2.1 OVERVIEW

Commercial deployment of renewable energy technology (RET) projects faces numerous barriers and risks, helping explain the low rate of take-up of these technologies in low-income countries (LICs). Perhaps most obvious is the high financial cost of RETs relative to conventional generation technologies using fossil fuels. As long as energy prices fail to properly internalize externalities and specifically take into account the wider global and local environmental impacts of different technologies as well as their contributions to reducing the price volatility of energy and increasing energy security, many RETs will continue to cost more than conventional technologies. Inevitably, this will deter their use, particularly in countries where affordability is a major concern. Energy prices also fail to reflect the other benefits that RETs may offer—notably the ability to diversify the supply mix and reduce the reliance on fossil fuels and imported fuels that may be subject to large price changes or interruptions in supply, and to locate generation nearer to demand centers, reducing the need for large and costly transmission infrastructure.

Lack of experience and familiarity with RETs also forms a major barrier in many LICs. Policy makers, financiers, off-takers (power purchasers), and sponsors are unable to assess the feasibility, viability, and risks of projects with confidence and, consequently, are reluctant to develop these. This can lead to the creation of a low-level equilibrium "trap": a lack of capacity and expertise means a failure to develop a pipeline of bankable projects, even where suitable opportunities exist. In turn, the lack of such a pipeline means that expertise and capacity in RET projects cannot be developed.

These fundamental barriers cannot be addressed through publicly financed instruments alone—although they can contribute. Wider reforms in the policy and regulatory framework and in building institutional capacity are needed. What financial instruments can do is help overcome specific barriers and risks that can hold back the development of RET opportunities even where the overall framework is supportive of these.

The barriers and risks that financial instruments can target can be grouped into two broad categories. The first category comprises barriers deriving from underdeveloped financial markets, making it difficult or impossible to obtain the types of financing required at reasonable costs. While these barriers are not unique to RET projects, but are common across most if not all infrastructure projects in LICs, they are exacerbated by the particular characteristics of RETs.

The second category is that of risks more specific to RETs alone. An example includes risks linked to regulation of the sector, increased by the nature of a given RET. Risks associated with the performance of the technology itself are excluded from this list—these are generally better addressed through warranties and guarantees from suppliers and contractors than through the use of financial instruments.

2.2 FINANCING BARRIERS

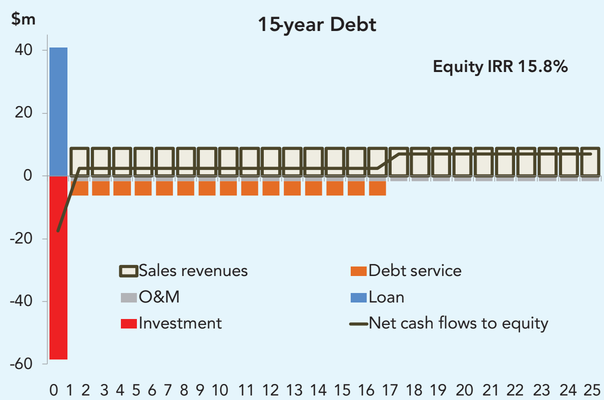
Lack of Long-Term Financing

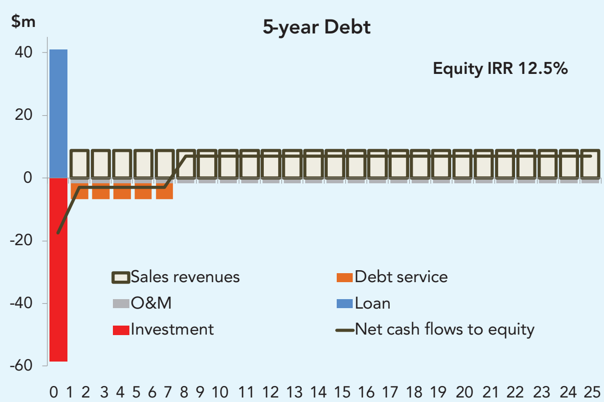
RETs are generally characterized by relatively high up-front capital costs and low ongoing operating costs, due to the nature of the technologies concerned. This implies a need for RET projects to be able to access long-term funding. In the absence of such long-term financing, investment decisions will be further biased toward conventional technologies that might be financially viable even with shorter loan terms.

Long-term financing is often difficult or even impossible to obtain in many LICs, which may be in part due to regulatory or other restrictions on long-term bank lending. A lack

BOX 2.1 ILLUSTRATIVE CASHFLOW PROFILES FOR RETS

Illustrative cash flows for a 35 megawatt (MW) onshore wind project can be used to show the importance of obtaining long-term financing for RET projects. In these two examples, the only change is the term of debt available to the project. The result of a 5-year debt term is to push the project into deficit for the first 5 years of operations—for a total of $15 million in financing that would have to be made up by the sponsor—and to reduce the return on equity below the threshold of viability.





Source: Calculated using data from Projected Costs of Generating Electricity 2010, IEA.

Note: O&M = operations and maintenance.

of experience with RETs means many potential financiers will feel unable to assess the risks involved; there may also be a lack of matching funding sources. Long-term financing is heavily dependent on investors looking for long-term assets to match the profile of their liabilities—such as pension funds. In many LICs, such funds either do not exist or limit investment activities largely to the purchase of government debt owing to its low risk.

In the smallest LICs, the major financing barrier may simply be a lack of capital market funds. Where financial resources are constrained, these will inevitably be directed toward those investment opportunities offering the highest returns at lowest risk and in the shortest time frame. RET projects are unlikely to be included among these.

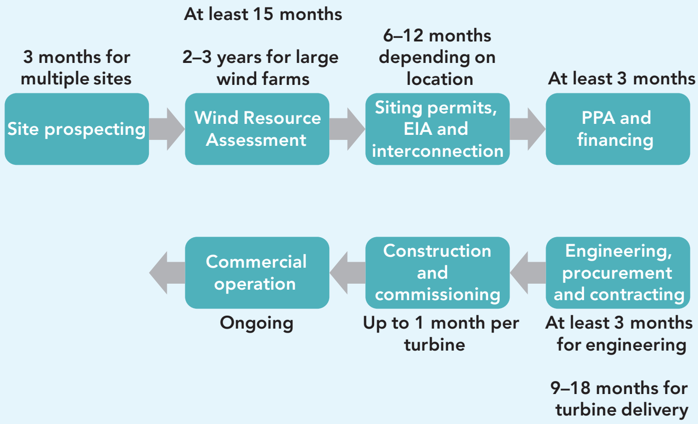
Lack of Project Financing

As well as long-term financing, RET projects will also be looking to access funds on a project finance basis—where the security for the loan comes from future project cash flows and where little or no up-front collateral is required, although there will still be a need for a share of the project to be funded from equity. Non- or limited-recourse funding of this type allows RET projects to spread their costs over the project lifetime, funding the high up-front cost from the positive cash flows generated during operations. The alternative is to rely heavily on equity funding, payments to which can be delayed until the later years of the project.

RETprojects are more exposed to the limited availability of project financing than most conventional technologies, as the share of capital costs in their total cost is much greater. Conventional technologies will also generally find it easier to attract equity financing and, potentially, corporate financing of investment costs as a whole. This is in part due to the lower capital investment required by these technologies, and also the much greater familiarity of most potential project sponsors with conventional technologies.

BOX 2.2 THE PROJECT DEVELOPMENT TIMETABLE FOR WIND

A typical project development timetable for wind projects, shown below, illustrates the length of the development process. Even at the soonest, this would take 2 to 3 years to reach financial close; site identification and resource assessment in particular take time. Substantial preinvestment financing is needed to cover the costs up to the point where revenues are generated, and to allow for the risk of delays.



Source: Bankable Wind Resource Assessment, Tetra Tech (2011). RET

High and Uncertain Project Development Costs

While all major infrastructure projects will tend to suffer from slow, costly, and uncertain project development and approval processes, particularly in LICs, these are again likely to be exacerbated for RET projects for multiple reasons. Such projects are often located in environmentally and socially sensitive areas. Land-use requirements for larger solar and wind projects, in particular, can be very significant. Renewable energy sources are frequently most abundant in areas at considerable distances from existing transmission and distribution grids, resulting in lengthy negotiations over grid extensions and the funding of these. A lack of experience with RETs will slow the approval process as the concerned agencies will find it harder to assess applications. The need to conduct assessments of potential renewable energy resources will further lengthen the process (wind projects, for example, need at least one year of reliable site-specific data on wind resources to be able to assess their viability).

All this makes it vital that RET project sponsors have access to significant amounts of funds to cover the costs of project development prior to reaching financial close. Such funds will generally need to come from their own resources or from sources of risk capital[3] such as venture capital funds. The small size of most potential RET project sponsors in LICs means that funding from this route is limited. And there is generally little availability of risk capital in LIC financial markets.

Lack of Equity Finance

Linked to both the need for long-term project financing and limited access to preinvestment financing is the challenge posed by the lack of equity finance available for many if not most RET projects. While large numbers of

3 Risk capital is considered to be funds that are seeking high returns and are willing to assume high levels of risk to achieve these.

BOX 2.3 TECHNOLOGY AND PROJECT SIZE IN THE GEF PROGRAM

As an example of the sizes of investments in RET projects, the portfolio of projects financed through the Global Environment Facility (GEF) includes:

- *Concentrating solar power*. Three projects with total capacity of 70 MW and cost of $1.04 billion (average project size of $350 million or 23 MW).
- *Off-grid photovoltaic*. Seventy projects with total capacity of 124 MW and cost of $3 billion (average project size of $42 million or 1.8 MW).
- *On-grid photovoltaic*. Twenty-one projects with total capacity of 40 MW and cost of $1.76 billion (average project size of $84 million or 1.9 MW).
- *Wind*. Forty projects with total capacity of 1 gigawatts (GW) and cost of $2.15 billion (average project size of $31 million or 25 MW).
- *Geothermal*. Eleven projects with total capacity of 927 MW (electricity) and cost of $1.8 billion (average project size of $160 million or 84 MW).
- *Small hydro*. Forty-four projects with total capacity of 411 MW and cost of $1.5 billion (average project size of $34 million or 9.3 MW)
- *Biomass*. Fifty projects with total capacity of 330 MW and cost of $2.3 billion (average project size of $46 million or 7 MW).
- One project may include a number of individual subprojects, each of which represents a single generator. Therefore, the average investment for each generator will be smaller than the project averages given above.

Source: Investing in Renewable Energy: The GEF Experience, GEF (2010).

RET project developers exist, there are only limited numbers of large-scale project sponsors, particularly among those operating in LICs, with the ability and willingness to fund RET projects on a corporate finance basis. RET projects are generally smaller than conventional generation projects, and this is reflected in the size of developers. The high risks of investment in many LICs, whether inside or outside the energy sector, will also tend to deter many larger energy companies based in more developed economies.

This lack of equity capital means that project sponsors are often unable to cover the costs of development activities without external assistance. But, as highlighted above, access to risk capital of the type required is limited in LICs. The lack of equity capital also increases the dependence on project financing, as sponsors are unable to provide collateral for loans or to put up large amounts of equity. As a result, loans have to be secured against future cash flows, given the absence of alternatives.

Small Scale of Projects

The small scale of many RET projects creates significant problems in obtaining private financing. Economies of scale in due diligence are significant, and many larger financial institutions will be unwilling to consider small projects. Typical due diligence costs for larger projects can be in the range of $0.5 million to $1 million. International commercial banks are generally not interested in projects below $10 million, while projects up to $20 million will find it difficult to obtain interest.[4] But lower limits may apply for domestic and regional banks operating in smaller economies, particularly where these lack the resources themselves to make large-scale loans.

4 Scaling-up Renewable Energy in Developing Countries: Finance and investment perspectives, K Hamilton (April 2010). Chatham House: Energy, Environment & Resource Governance Program Paper 02/10. (http://www.chathamhouse.org.uk/research/eedp/papers/view/-/id/874/).

While household, micro, and mini systems are obviously far below these limits, even larger grid-connected RET projects are generally smaller than their conventional counterparts. As a result, they often struggle to attract funding from larger financiers. These very small systems also face the problem of lack of local demand in rural areas, leading to underutilized assets and worsening financial returns and attractiveness to financiers.

2.3 RISKS OF RET PROJECTS

High Financial Cost

The high costs of RETs relative to conventional generation technologies are a key risk to their success. These higher costs are exacerbated by the high cost of funds in many underdeveloped financial markets (for example, borrowing costs as high as 16–18 percent have been quoted for Nepal and among other SREP pilot countries, lending rates of 16.5 percent and 15.1 percent have been reported by the International Monetary Fund [IMF] for Ethiopia and Honduras). The high up-front capital costs of many RETs compared to conventional technologies further worsen their commercial position and make costs a concern.

For grid-connected projects, the high cost of RETs can be overcome, at least in part, through priority rights to dispatch and/or must-take obligations on off-takers. This means that these projects are effectively removed from having to compete for dispatch with other lower-cost conventional technologies. The higher costs imposed on off-takers of purchases from RET projects are generally recovered from electricity customers as a whole—either through the monopoly power of the off-taker or, where the electricity market is competitive, through some form of levy or universal charge.

But if costs are too high relative to alternatives, affordability concerns may mean that such priority treatment is not given. There may also be concerns whether RET projects that are more expensive than conventional alternatives will have commitments to pay them honored, whether governments will continue to make the necessary funds available to cover the obligations of publicly owned off-takers, or whether attempts will be made to renegotiate these commitments on the grounds of affordability.

Off-grid RET projects are more likely to be competing directly with conventional technologies, such as diesel generation. For these projects, if users are given a choice of technology, RETs are unlikely to be selected unless their costs can be brought down to competitive levels. This is happening more as global oil prices rise. For example, the cost of solar photovoltaic (PV) modules fell by over 50 percent between 2008 and 2010. In remote locations and small loads, this can make solar PV supplies competitive with diesel generation.

High Exposure to Regulatory Risk

While all energy projects face regulatory risk, RET projects are particularly vulnerable to changes in the regulatory framework. Their lack of cost competitiveness means that these projects are generally dependent on a supportive regulatory framework to proceed—including commitments to pay premium prices, priority access to electricity grids including support for the necessary infrastructure investments, and guarantees of purchases of their output. Severe problems for project viability can arise where the regulatory framework changes.

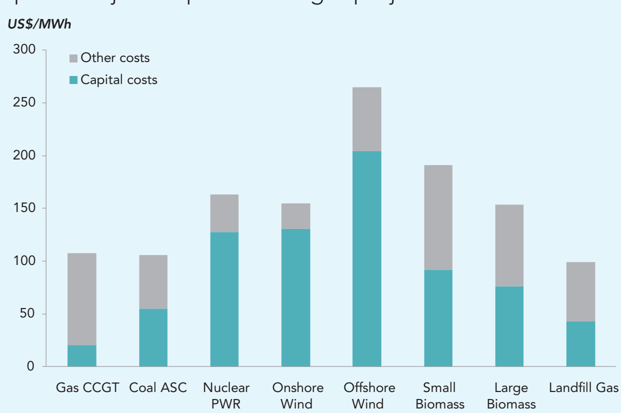
Uncertainties over Carbon Financing

The sale of Certified Emissions Reductions (CERs) through the Clean Development Mechanism (CDM) is a widely recognized

BOX 2.4 COSTS OF RETS

The U.K. Government has undertaken a number of studies on the cost competitiveness of RETs, and in particular whether expansion of RET capacity is reducing costs to the extent where these are competitive with conventional technologies before any carbon costs are included. Though the United Kingdom is not a LIC, these studies provide good examples of the cost competitiveness of larger-scale RETs relative to conventional technologies.

The most recent update, in June 2010, continues to show RETs as being uncompetitive with gas and coal generation, even for the most mature technology, onshore wind. Notable too is the high share of capital costs in total lifetime RET costs, amounting to 80 percent for wind projects compared to just 20 percent for gas projects.



Source: UK Electricity Generation Costs, Mott MacDonald, 2010 ***(carbon costs ignored)***.

source of revenue for RET projects in LICs, and one that can help reduce their costs relative to conventional technologies (in effect acting as a form of subsidy). But unless some way can be found to mobilize this potential revenue source up front, it is unlikely to help at the time of project development and implementation.

There are significant uncertainties over the timing and amounts of revenues from the sale of CERs. The process for registration of projects is long and the outcome uncertain, particularly if a new methodology is involved. Prices can also be volatile. The main benchmark price is that set under the EU Emissions Trading Scheme (ETS), which collapsed to almost zero during 2008. Finally, there is the uncertainty over the CDM post-2012 created by the lack of a replacement for the Kyoto Protocol, which forms the basis for the mechanism.

Uncertainties over Resource Adequacy

Without high-quality assessments of renewable energy (RE) resources, the risks of RE projects are greatly magnified, and private financing will be correspondingly harder to obtain. Resource assessments for wind, hydro, and biomass in particular need to be available on a site-specific basis (that is, general assessments such as wind atlases are not sufficient for project financing) and for an extended period (at least one year of reliable and auditable data, for example). Even then, the risk remains that output—and therefore cash flows—will be less than expected, whether due to lack of rain or wind.

For solar projects, the problems are somewhat different. There are extensive databases available on solar resources worldwide; whether conditions are adequate for PV technology can be estimated with a fair level of certainty. The situation is rather different for the use of concentrating solar power (CSP), which is only suitable in a limited number of locations and where careful investigation of resources continues to be required. But CSP remains a much more immature technology, and therefore may not be suitable for most LICs or at least for the transformative purposes envisaged by this paper.

Geothermal projects face a particular risk in that the assessment of resources involves the drilling of expensive exploratory test wells, which may not succeed in finding adequate resources. The costs of these wells are high and the combination of this high cost and risk of failure may deter exploration of geothermal resources in the first place. As a result, while many countries claim that they have significant geothermal recourses, very little potential has been developed so far. Even where an exploration program is successfully completed, there are continued risks of resource adequacy from the failure of production drilling wells and the degradation of the geothermal reservoir over time.

2.4 THE SIGNIFICANCE OF TECHNOLOGY

Different technologies have different degrees of exposure to the various identified barriers and risks. While all larger RET projects will generally require access to long-term funding on a project finance basis, their exposure to other barriers and risks will differ. Project development processes and, therefore, the need to obtain preinvestment financing are likely to be most significant for hydro projects and less so for other technologies that do not have the same impacts on land use and on downstream communities. Project sizes—and therefore transaction cost barriers—are generally lower for wind and geothermal projects that can be developed on a greater scale than other technologies. While geothermal and small hydro can be competitive with conventional technologies and wind energy is approaching competitiveness in some countries, solar technologies in particular remain a long way from achieving cost competitiveness, and so affordability remains a key risk. Resource uncertainties are a problem for all technologies, but in differing ways. For geothermal projects, the greatest risk comes at the time of resource appraisal, when expensive drilling of exploratory wells is needed. For biomass projects, the continuing availability of affordable and adequate resources is more significant. Resource uncertainties also play a part in the extent of uncertainties over carbon financing—with those technologies likely to be more dependent on carbon financing to cover their costs also being more vulnerable.

The risks and barriers facing off-grid projects also differ from those of on-grid RET projects. These projects are generally reliant on sales of individual household or small-scale systems to rural communities. While technical challenges may be limited, affordability and financeability become key. Also, the very small scale of such projects, down to the individual household level, means transaction costs can become an almost insurmountable barrier. But it can also be that the lack of long-term project financing is actually less of a barrier to such projects—given their very small size, typically they would rely on corporate finance or on customer purchases.

A stylized representation of the significance of different barriers and risks to different technologies is presented in figure 2.1. While inevitably subjective—it is extremely difficult to conduct rigorous statistical analysis across very different projects in very different circumstances—it provides an indication of which barriers and risks are likely to pose the greatest challenges to developing RETs.

Lack of market funds is not included in the figure. This financing barrier could affect any technology and is driven by the size of domestic capital markets, not the specific risks of any technology.

FIGURE 2.1 TECHNOLOGIES AND BARRIERS AND RISKS

	FINANCING BARRIERS					PROJECT RISKS				
	Lack of Long-Term Financing	Lack Of Project Financing	High and Uncertain Project Development Costs	Lack Of Equity Finance	Small Scale of Projects	High Financial Cost	High Exposure to Regulatory Risk	Uncertainties Over Carbon Financing	High Costs of Resource Assessments	Uncertainties Over Resource Adequacy
On-Grid										
Wind	Hi	Med	Lo	Lo	Lo	Med	Med	Med	Lo	Med
Solar	Hi	Med	Lo	Med	Med	Hi	Med	Med	Lo	Med
Small hydro	Hi	Med	Med	Med	Med	Lo	Med	Lo	Med	Hi
Biomass	Hi	Med	Lo	Lo	Med	Med	Med	Med	Lo	Hi
Geothermal	Med	Med	Hi	Med	Lo	Lo	Med	Lo	Hi	Med
Off-grid										
Solar/ micro-hydro	Med	Lo	Med	Hi	Hi	Med	Lo	Lo	Lo	Med

Source: Authors.
Note: Lo = Small or no impact (mitigation of risks is desirable); Med = Moderate impact (mitigation of risks is likely to be required); Hi = Significant impact (mitigation of risks is generally necessary if the project is to proceed)
Lack of market funds is not included in the figure. This financing barrier could affect any technology and is driven by the size of domestic capital markets, not the specific risks of any technology.

3 Financial Instruments

3.1 OVERVIEW

A wide range of financing instruments can be applied in support of the scaling up of renewable energy technologies (RETs). These can be broadly grouped into those used to overcome financing barriers, those used to address the specific risks of RET investments, and those that address both simultaneously (as, for example, where financial markets lack the sophistication to offer risk management instruments suitable for RETs). These various instruments can in turn be distinguished by both the level of risk assumed by the public sector entity funding the instrument concerned, and by the level of leverage (the extent to which public funding mobilizes private finance) involved.

Figure 3.1 illustrates this. Instruments are organized on the horizontal axis by their primary focus—whether to address underdeveloped financial markets, the risks and costs of RETs, or both. On the vertical axis, instruments are organized by the level of risk and leverage associated with their use. Pure grants are considered to be the most risky, as these give the public sector no control over the funds contributed and no recourse. Equity is next; although it comes with control, shareholders are the last to be compensated from the project. This is followed by debt in its various forms.

In general, the amount of leverage associated with the different forms of financing will follow the opposite pattern as the level of risk. But the selection of instrument must always

BOX 3.1 LEVERAGE AND FINANCIAL INSTRUMENTS

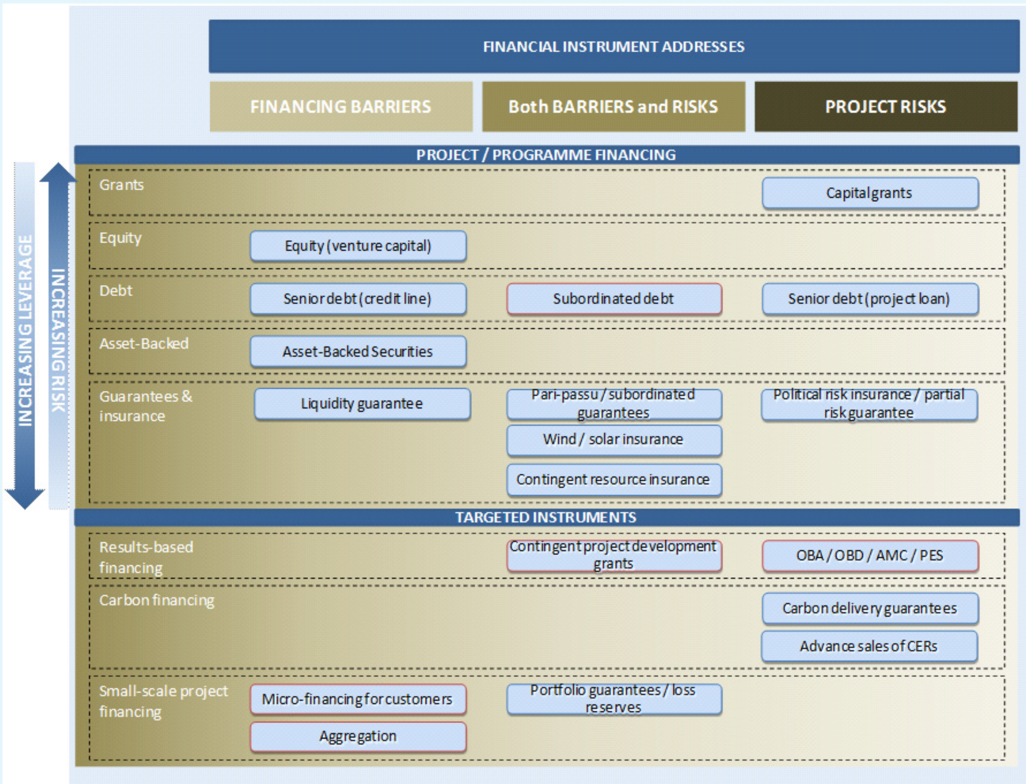
Leverage is the additional funding that is mobilized by the instrument concerned. For example, if the contribution of $1 in funding through the instrument leads to an additional $1 in financing from other sources, then the leverage will be two times as much.

As an example of the leveraging that can be delivered with different instruments, assume that $10 million in public funds is available for RET investments. One option would be to inject these funds directly into individual projects. Another would be to offer guarantees for project investments. Assuming that the guarantee is for 50 percent of debt financing, and that debt represents 80 percent of the total project financing, then $1 of public funds would guarantee $2 of debt financing and $2.50 of project financing. The resulting leverage would be 2.5 times. Experience with World Bank guarantee instruments has shown even higher levels of leverage. During the period 2004–06, six guarantee operations were concluded for a total exposure of $444.5 million mobilizing a total of approximately $1.933 billion (that is, average leverage of approximately 4.3 times). Meanwhile, direct injection of funds may not deliver any additional private investment.

While leverage provides a good measure of effectiveness, it may not be as useful in measuring the efficiency of interventions. For example, an intervention may achieve high leverage but does so by transferring private investment from other more valuable uses. An assessment of the choice of instruments must, therefore, take account of the risks of crowding out and of creating market distortions.

Source: Authors.

FIGURE 3.1 THE RANGE OF FINANCIAL INSTRUMENTS



Source: Authors.

Note: The risks and barriers are shown across the horizontal axis, with instruments shown below. Those instruments occupying the middle of the three columns are potentially suitable for addressing both risks and barriers.

AMC = Advanced Market Commitments; OBA = output-based aid; OBD = output-based disbursement; PES = payment for environment service.

take account of the particular needs of an individual project or program as well as legal and practical restrictions that may apply.

Figure 3.1 also identifies three further categories of instruments that have specific uses: funding delivered on the basis of results, instruments targeted on realizing potential revenues from carbon markets, and instruments specifically focused on the barriers and risks facing small-scale RET projects and programs. For further descriptions of individual instruments, consult appendix 2 and www.worldbank.org/energy/refine.

3.2 GRANTS AND LONG-TERM EQUITY

Capital grants fund part of the investment costs of an RET project, generally in an effort to reduce its ultimate financial cost to increase its competitiveness, or—where off-takers are obliged to purchase its output—to reduce ultimate customer prices (the use of grants as part of a results-based financing mechanism is discussed separately). Simple grants provide no control over the project itself and create no incentives on the project developer to deliver a viable project (unlike a loan, where the project needs to generate sufficient revenues for repayment), but they may be necessary as a means of reducing the costs of a project sufficiently to make it affordable. They also have the advantage of being relatively simple to implement and manage—the need for due diligence on the ability of the project to repay as well as for ongoing administration of loans is unnecessary. This does not, of course, eliminate the need to ensure the project itself is well designed to meet the objectives that the provision of the grant is intended to further.

GRANTS

Uses

- Reduce project costs and provide long-term finance (capital grants).
- Provide long-term finance (equity holdings).

Pros

- Relatively simple to implement.
- Do not require ongoing administration.

Cons

- High risk in terms of achieving objectives as they do not create incentives for delivery.
- If grants are made in return for equity then the public sector is involved in the control of projects, which may lead to poorer performance and the crowding out of private financing.
- Low levels of leverage as it directly replaces possible private financing.
- No return on capital that could have been used to finance further projects.

Within the category of grants, we include capital contributions made in return for a shareholding in the project company (that is, long-term equity investments). Public agencies could, of course, also subscribe to shares in the same way as commercial investors. But this is not considered to represent any intent to leverage public funds to support RET investments, and is therefore excluded from this paper. Capital contributions of this kind can raise their own problems in that, where a large grant is made, it may lead to the public funding agency becoming the majority shareholder. Control by a public agency compared to a private developer creates the risk of the project suffering from the problems of many publicly managed projects: poor management of costs and performance and high risks of political interference.

A particular form of grant is the viability gap funding mechanism, widely deployed in India in particular. Under this funding, the government can provide capital grants for a share of project costs, where the project would otherwise not be viable due to the constraints on user fees that can be charged. In India, the viability gap fund administered by the central government will pay up to 20 percent of a project's costs; sponsoring ministries and agencies can contribute a further 20 percent, requiring the developer to pay at least 60 percent of the costs.

3.3 VENTURE CAPITAL EQUITY

Equity funding from public sources to support RET scaling up can comprise long-term investments, as discussed above under capital grants, or venture capital financing, which represents equity investments intended to develop high-risk projects followed by exit.

Venture capital financing is generally targeted at new technologies and companies with a high growth potential. Financiers look to make their returns by exiting the investment, typically through an initial public offering (IPO) on the stock market or sale to a larger company interested in acquiring the business's technology. Funding of this type is high risk, and the returns required reflect this. It also requires sufficiently developed financial markets for the initial financiers to be able to readily exit their investment through a sale of their shareholding in what may still be a relatively small and risky business. Given these requirements, such funding is unlikely to be well suited to RET investments in low-income countries (LICs), unless these use particularly innovative technologies that may make them attractive to an international investor.

EQUITY (VENTURE CAPITAL)
Uses
• Funds preinvestment costs as risk capital.
Pros
• Pays for itself.
• Strong incentives for project viability to enable potential gains to be realized.
Cons
• High returns are needed to compensate for the risk. Since public financing can accept lower returns, it reduces incentives and makes it harder for private providers of equity to compete.
• Low levels of leverage as it directly replaces possible private financing.
• Developed financial markets are needed to allow exit from investment through an IPO or a direct sale of shares.

3.4 DEBT

Debt, as used in this paper, refers to loans advanced to RET projects. Asset-backed securities are discussed separately.

Senior Debt

Senior debt provided from public sources, whether in the form of a project loan or credit line, will take its place among the first creditors to be repaid from a project. It is primarily used to reduce the costs of the project, by providing concessionary funds that may be blended with more expensive commercial funding, and to offer longer-term debt than may be available in local financial markets. Long-term loans from public sources can also help establish credibility among private financiers for longer-term lending to RET projects. A wide variety of debt amortization and repayment schedules can be used, allowing tailoring of debt service costs to project cash flows. For example, a bullet (one-off) repayment of the loan principal may be made at the end of the loan term, reducing debt service costs in the initial years of the project.

A distinction can be made between direct loans to project companies and the provision of credit lines extended through commercial financing institutions (CFIs) or other intermediaries. Credit lines can create incentives for intermediaries to extend their own loans to RET projects alongside that funded from the credit line as well as allowing blending of commercial and concessionary loans to reduce overall costs. The choice of intermediaries is discussed in chapter 4.

BOX 3.2 SRI LANKA RENEWABLE ENERGY PROGRAM

The World Bank is providing funding for investments in grid-connected, mini-hydro, off-grid village-level hydro and solar home systems (SHS). Funds are provided to the Ministry of Finance and Planning as an International Development Association (IDA) credit. Participating credit institutions (PCIs) are responsible for lending to eligible projects applying their own due diligence. Loans may be made directly to project sponsors or, for off-grid projects, to customers. Alternatively, PCIs may loan to microfinance institutions (MFIs) who on-lend to customers for the purchase of SHS. PCIs include development and commercial banks and leasing companies.

Once a loan has been made, PCIs may apply to the ministry for the refinancing of up to 80 percent of their loan. The refinancing is made in local currency. The mechanism thereby creates strong incentives for PCIs to conduct proper due diligence by retaining their liability for 20 percent of the loan and, where the project is not eligible, 100 percent of the loan amount.

Source: Case study #17: Sri Lanka—Renewable Energy Program.

SENIOR DEBT

Uses

- Reduces project costs.
- Provides long-term finance.

Pros

- Obligation to repay creates incentives for project viability.
- Repayment of principal frees funds for further support to RET projects.
- Used as a means to increase CFI involvement in RET projects (through provision as credit lines).

Cons

- Need for due diligence to verify ability of project to repay loan increases transaction costs.
- Leverage is limited and may crowd out potential private providers of debt.

Subordinated Debt (Mezzanine Finance)

For the purposes of this paper, subordinated debt is considered to encompass all forms of mezzanine or quasi-equity finance, of which there are many variants. The key features these share in common are that repayment is subordinate to providers of senior debt (hence the name), and that the financier does not obtain a shareholding and thus control of the project (although some forms of subordinated debt may be capable of conversion to shares or, as in the case of preferred shares, take the form of equity but with lesser or no rights of control). This higher risk is generally compensated for by a higher return than on senior debt. But a public agency may choose to provide subordinated debt at a concessionary cost similar to or below that of senior debt.

Subordinated debt is extremely valuable as a means of financing RET projects. It allows project developers to reduce the risk to senior lenders by reducing the share of senior debt in total project financing, while still retaining control of the project. By doing so, it can make senior debt less costly or even make it available where it previously was not. Subordinated debt can also be used to extend the effective term of loans, thus helping project cash flows and viability.

BOX 3.3 USING SUBORDINATED DEBT TO EXTEND LOAN TERMS

Subordinated debt is generally thought of as a means of increasing the share of equity or quasi-equity in projects and, therefore, attracting senior lenders who require a minimum equity share in project financing. But it can also be used to effectively extend the term of loans.

Repayment of the principal of subordinated loans might only begin after an extended grace period or even after all senior debt has been repaid. Subordination in this way improves the cash flows of the project in earlier years and, therefore, reduces the risk to senior lenders of default. This can increase the willingness to lend and to accept longer loan terms.

Source: Case study #4: Macedonia—Sustainable Energy Financing Facility.

SUBORDINATED DEBT (MEZZANINE FINANCE)

Uses

- Provides intermediate funding between equity and senior debt, which helps reduce risks to senior lenders while not taking control away from project sponsors.
- By doing so, can extend the term and reduce costs of senior debt.

Pros

- High level of leverage.
- Crowds in senior debt by allowing projects to meet acceptable risk criteria for lenders.

Cons

- It is generally custom designed for each project, implying high transaction costs.
- Significant risk transferred to public financing agencies, but with only limited ability to control these risks.

3.5 ASSET-BACKED SECURITIES

Asset-backed securities are bonds or similar instruments, which are backed by the cash flows generated by a RET project or projects (rather than being corporate bonds backed by the assets of a company as a whole). These cash flows form the security for repayment. The process of raising finance in this way, secured against future cash flows, is frequently termed securitization.

Asset-backed securities are generally used for refinancing projects that are generating positive cash flows, although they can also be issued in the form of project bonds ahead of construction. Such refinancing offers a potential way to free up public funds that have been committed for development and investment, thereby allowing these funds to be redeployed to support new projects.

As well as freeing up development funds, asset-backed securities allow the potential bundling of a number of RET projects by issuing bonds secured against the cash flows of multiple projects. By doing so, they can increase the financing capabilities of CFIs. For example, if a CFI is required to hold reserves to cover the full risk of default, then—if lending to 10 individual RET projects, each of which has a 10 percent probability of default—it would need to hold reserves equal to the original loans.[5] If instead it purchased a bond secured against all 10 projects, then it need only hold reserves equal to 10 percent of the total bond value, as the probability of any one project defaulting remains at 10 percent.

[5] This is an extreme and greatly simplified example used to illustrate the benefits of bundling. In reality, reserve requirements are much more complex than this example implies. It would also be unrealistic to assume that the risks of default of what would be very similar projects operating in the same market are uncorrelated and independent of one another.

ASSET-BACKED SECURITIES

Uses

- Offer project financing through bond offerings rather than through loans.
- Free public funds for future RET project development when completed projects are refinanced.

Pros

- Longer tenor and possibly lower cost than bank financing.
- Ready means to refinance projects, freeing developer funds for further investments.
- Potential to bundle projects together in a single security can reduce risks and, therefore, financing costs
- Can be a good tool for expanding capital market offerings given the relative low risk of some RETs (because of their guaranteed offtake).

Cons

- Sophisticated markets required to be able to analyze and price the risk associated with this type of security.

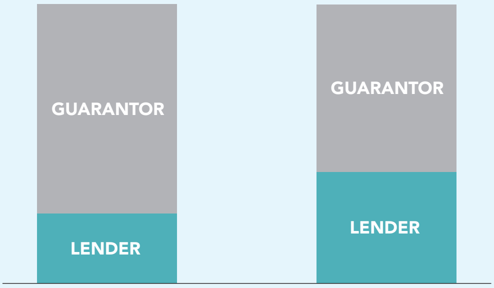
Asset-based securities require relatively sophisticated financial markets able to analyze and value the risks associated with such securities and, consequently, to price them. The experience with mortgage-backed securities in the recent financial crisis shows how even the most sophisticated markets can get this wrong by, for example, assuming past statistical relationships will continue to hold and by failing to properly understand the individual loans that comprise the security. Their suitability for the vast majority of LICs should be considered on a case-by-case basis.

3.6 GUARANTEES AND INSURANCE

Guarantees and insurance do not comprise direct financing as such. Instead, by offering protection to financiers against risks, they make it possible to mobilize commercial financing for the necessary terms and at acceptable costs.

BOX 3.4 VARYING LOSS SHARES

The figure below shows the sharing of losses under a guarantee of the type described in the main text, where the share of losses borne by the lender increases over time as its ability to manage these increases.



Both guarantees and insurance represent an agreement by the guarantor or insurer to pay part of the costs or losses incurred by a RET project in the event of a specified event happening in return for the payment of a fee or premium. The difference lies in the commercial arrangements. A guarantee is a three-way relationship with the guarantor offering the guarantee to one entity (the financier) against the performance of another entity (that receiving the finance). Insurance is a two-way relationship between the insurer and the insured (typically the entity providing finance) without a need for the entity receiving the financing to be involved. The financier would expect to receive the proceeds of any insurance payout to provide them with the necessary protection against the performance of the financed entity.

By their nature, guarantees tend to be more one-off or bespoke in nature involving the guarantor in extensive due diligence and in the design of the project, while insurance tends to be better suited to more developed markets where insurers can offer standard products and can assess the risks involved based on extensive data.

Individual Guarantees

An individual guarantee covers a portion of the losses to the financier (for loans, this would typically be unpaid principal and collection costs, but not necessarily unpaid interest) if specified events occur. A guarantee would not cover all potential losses as doing so would obviously remove the incentives on the financier to conduct proper due diligence or to seek to recover unpaid amounts. The split of losses might vary depending on the magnitude, for example, to protect the financier against more extreme losses or to reflect expected improvements in the ability of the financed entity to manage their risks over time. As an example, a guarantee might split the first 10 percent of losses on the project between the guarantor and

BOX 3.5 USING LIQUIDITY GUARANTEES

An example of an innovative use of liquidity guarantees to support a RET project is provided by the funding of part of the investment costs of the West Nile Rural Electrification Project in Uganda. Under Ugandan regulations, loans may not be provided for a term exceeding 8 years. To allow for a longer-term loan, two separate senior loans were structured. The first expires after 8 years when a bullet repayment of the outstanding principal is to be made. This repayment is funded from a new 7-year loan. The total period over which both the loans are repaid is, therefore, 15 years.

A liquidity guarantee has been used to ensure that sufficient funds are available to make the second loan after 8 years, thereby removing this risk for the project developer.

Source: Case study #5: Uganda—West Nile Rural Electrification Project.

lender in a 75:25 percent ratio with subsequent losses being split 60:40 percent (a structure illustrated in the accompanying box). Assuming the first losses would occur in the earlier stages of the project, this provides incentives for the project company to improve its performance over time before it starts to bear a larger share of any losses.

Guarantees might take the form of either a **pari-passu** or **subordinated guarantee**. The difference between the two lies in the treatment of unpaid sums that may be subsequently recovered. Under a pari-passu guarantee, recovered monies are shared in a preagreed ratio between the financier and the guarantor while, under a subordinated guarantee, the recovered monies are first used to repay the financier and only after this are any remaining amounts used to repay the guarantor. The latter obviously reduces incentives on the financier to recover unpaid amounts, and affects risks to the guarantor and, therefore, the guarantee fee required.

Figure 3.1 also identifies two specific types of guarantee. The first is a **liquidity guarantee** where the guarantor is guaranteeing that the guaranteed entity has sufficient funds to meet its obligations. For example, hydro projects may have very volatile revenues depending on rainfall in the year. In these cases, a liquidity guarantee can provide assurance that the project will be able to service its debts in dry years.

The second is specifically targeted on the political or regulatory risks associated with many RET projects in LICs and takes the form of **political risk insurance** (PRI) or a **partial risk guarantee** (PRG). These are offered by a number of multilateral institutions and bilateral credit agencies, including the IDA, International Bank for Reconstruction and Development (IBRD), International Finance Corporation (IFC), and Multilateral Investment Guarantee Agency (MIGA) within the World Bank Group (WBG). Such a guarantee will typically cover the risk that a project defaults due to the actions of government or public sector agencies. These might include, for example, expropriation or a breach of contract that cannot be relieved by other means, regulatory actions that have severe economic impacts on the project, or limits on currency convertibility. PRGs offered by the IDA and IBRD are secured against a matching counter-guarantee from the host country government (so that, if the PRG is called, the IDA or IBRD may then seek recovery of the costs of the guarantee from the government). This acts as a very powerful incentive for the host country government to meet its obligations. The MIGA by contrast offers an insurance product in that the PRI has no counter-guarantee.

BOX 3.6 PARTIAL CREDIT GUARANTEE (PCG) FOR LEYTE GEOTHERMAL

The Leyte-Luzon geothermal power plant was implemented by the National Power Corporation (NPC) and the Philippines National Oil Company (PNOC), both state-owned corporations. The NPC raised $100 million in project financing through 15-year bonds issued on international capital markets. The bond issue was covered by a Partial Credit Guarantee (PCG) provided by the World Bank. Under the PCG, bondholders have a "put" option to sell their bonds to the World Bank on maturity in return for repayment of the principal. This option provides the necessary confidence to investors that such long-term bonds will be honored when they become due at the end of their tenor. The bonds were successfully placed, despite the previous longest tenor obtained by a Philippines sovereign entity being only 10 years, and at a price of only 250 basis points above U.S. Treasuries, which compares very well with previous bond issues.

Source: Case study #24: Philippines—Leyte Geothermal Partial Credit Guarantee.

INDIVIDUAL GUARANTEES

Uses

- Guarantee a part of the losses incurred by a project in the event of a specified event occurring.
- Guarantee ability to meet commitments on debt servicing / financing (liquidity guarantee).
- Guarantee policy and regulatory commitments by host government (PRI/PRG).

Pros

- Guarantees are targeted to specific risks deterring private investment, thereby minimizing the risk of market distortions and being an effective means of crowding in private investment.
- A high degree of leverage as a relatively small commitment of funds can mobilize significant quantities of private investment.
- No need for large up-front payment, making it easier to obtain political approval.

Cons

- Generally are custom designed for each project, implying high transaction costs.
- Significant risk is transferred to public financing agencies but with only limited ability to control these risks.
- Appropriate accounting for and approval of the resulting contingent liabilities is required, which may be complicated by difficulties in assessing the associated risks.
- Ability to avoid up-front funding may encourage excessive use of guarantees for political reasons and favored projects.

Resource Insurance

General insurance for business interruption, damage to equipment, and similar risks is considered to lie outside the scope of this paper. The RET-specific insurance covered in this chapter is instead related to the management of resource risks. For technologies that are inherently dependent on uncertain resources, wind and solar insurance can be used to provide coverage against unusually cloudy or still periods.

BOX 3.7 PRG FOR LAO PDR HYDROPOWER

The Nam Theun 2 Power Project is a $1.25 billion hydropower project. It reached financial close on June 10, 2005, after mobilizing an unprecedented $1.17 billion in private capital. At the time of project preparation, the private sector had indicated that the project would only be possible with a risk mitigation package backed by the World Bank to contain the political and regulatory risks of investing in the power sector in Laos, and the dependency on revenues from neighboring Thailand through exports of power.

The WBG provided an IDA PRG of $42 million, a MIGA debt guarantee of $91 million, and a MIGA equity guarantee of $150 million. Additionally, the IDA provided a credit of $20 million to the Government of Laos.

Source: Case study #33: Laos—Nam Theun 2 Project.

Insurance would generally not be available for hydrology risk or for biomass projects. Hydrology risk is very location specific making it difficult for an insurer to assess the probability of a dry year or to diversify this risk against increased hydro flows in other insured sites. Insurance of the availability of biomass resources is also site specific and could create potential perverse incentives for the insured RET project to minimize its efforts to obtain adequate supplies.

Even where insurance of this kind is available, which may be the case in some more sophisticated financial markets, there may still be a role for public agencies to support the provision of reinsurance (effectively insuring the insurers), which then releases the funds of the insurers in a similar way to other mechanisms for bundling projects for the purposes of managing risks.

RESOURCE INSURANCE

Uses

- Insures against lost revenue in the event of lower-than-expected output due to lack of wind or sun (wind/solar insurance).
- Insures against costs of failed exploratory wells (contingent risk insurance for geothermal projects).

Pros

- Targeted on specific risks deterring private investment, thereby minimizing the risk of market distortions and being an effective means of crowding in private investment.
- A high degree of leverage can be achieved as a relatively small commitment of funds can mobilize significant quantities of private investment.

Cons

- A large number of projects with diversity of locations are required for the insurer to be able to diversify their risk exposure away from any one project.
- A large database of historic performance is required for insurers to be able to assess and price risks.
- For these reasons, resource insurance either needs multinational insurers or large and sophisticated domestic financial markets combined with large volumes of existing RET projects.

A form of insurance specific to geothermal projects is that of **contingent resource insurance.** Geothermal projects require the drilling of costly exploration wells to assess whether adequate resources exist. Contingent resource insurance pays part of the costs of these wells where they prove unsuccessful. There has been significant interest in the creation of such schemes including the World Bank-supported GeoFund and the separate initiative, the African Rift Geothermal (ARGEO) project supported by the Global Environment Facility (GEF), for exploration in Eastern Africa's Rift Valley.

3.7 RESULTS-BASED FINANCING

Payment against Outputs

Results-based financing (RBF) links the payment of funds to the delivery of specific outputs. There are many variations of such funding and many names used by different members

BOX 3.8 INSURANCE FOR RET PROJECTS IN LICS

Substantial work has been undertaken by the United Nations Environment Programme (UNEP) on the extension of insurance offerings for RET projects in LICs. This has helped lead to the establishment of insurance4renewables, which offers case-by-case coverage for RET projects including carbon delivery guarantees, carbon counterparty credit risk insurance, and lack of sun/wind insurance.

Source: Case Study #26: Global—insurance4renewables

Other insurance products previously tried include the GEF-supported GeoFund. This offered direct investment funding ($8 million), technical assistance ($7 million), and geological risk insurance (GRI) ($10 million) for geothermal projects in Europe and Central Asia. The GRI window was used in Hungary in 2006–07 to insure 85 percent of the costs of drilling two exploratory wells to support exploration of these resources. In the event, both wells were found to have insufficient pressures to support geothermal applications and a payment of $3.3 million was made to the implementing entity. Although the GeoFund initiative was later cancelled, it continues to serve as a model for a similar mechanism being used to support geothermal development in the Rift Valley in Eastern Africa.

Source: Case study #10: Hungary—GeoFund.

of the development community to reference these variations. For the purposes of this paper, these are grouped under the term results-based financing. RBF is based on the concept of shifting from funding of inputs (such as a contribution to the capital costs of a project) to payment for outputs or results (such as the successful commissioning of the project) and, from this, the transfer of investment and operating risks from funders to implementing agencies. This concept of risk transfer is a critical element that needs to be captured in the design and is instrumental in a number of benefits derived from RBF.

A typical RBF approach involves a public entity providing a financial incentive, reward, subsidy, or grant conditional on the recipient undertaking a set of predetermined actions or achieving a predetermined performance or set of results. Funds are disbursed not against individual input expenditures or contracts on the input side, but against demonstrated and verified results that are largely within the control of the recipient. The recipient prefinances the activity based on the certainty that, as long as it delivers the pre-agreed service, it will receive payment. The credit worthiness of the funding entity and the track record of the recipient should allow the recipient to raise this prefinancing either internationally or locally. But where financial markets are significantly underdeveloped or project developers are small scale and have limited track records, this may not always be possible and RBF mechanisms may need to be combined with or supplemented by other financial instruments.

There are several ways of structuring RBF mechanisms. These include the following:

Output-based aid (OBA). OBA specifically refers to delivering outputs for low-income consumers. For the energy sector, OBA is typically used to increase access to energy services by the poor, by helping cover the difference between the full cost of supply and the affordable price to poor households. OBA subsidies can either buy down the capital cost of investments or can cover the difference between an affordable user fee and a cost-recovery user fee, for example, a consumption subsidy. OBA can also be used to support more efficient delivery of services that exhibit positive externalities, by tying payments for contracted-out services to the achievement of specified service performance levels or outputs.

Significant work goes into the design of OBA schemes. The subsidy is targeted for eligible low-income consumers. This can take the form of geographic targeting (that is, consumers living within a certain area are eligible) or using proxies for low-income consumers (such as

BOX 3.9 OUTPUT-BASED AID (OBA) FOR SOLAR HOME SYSTEMS (SHS) IN BOLIVIA

Under the World Bank–supported Decentralized Infrastructure for Rural Transformation (IDTR) project, 14 medium-term service concessions (MSCs) for SHS installation have been allowed. The MSCs give exclusive rights to the concessionaire for 4 years, during which period they receive subsidies for SHS installations and are required to achieve a given volume of installations. Subsidies are paid on an OBA basis with the following schedule:

- Fifteen percent on acceptance of a prototype system compliant with all quality specifications.
- Sixty-eight percent against achievement of installation targets
- Twelve percent against meeting annual visit requirements over the 4-year MSC period.
- Five percent at the expiry of the MSC, provided all obligations have been complied with.

Source: Case study #32: Bolivia—SHS Medium-Term Service Contracts.

BOX 3.10 AMCS FOR RURAL ENERGY SYSTEMS IN RWANDA

The U.K. Department For International Development (DFID) is supporting a program of AMCs for biogas digesters and micro-hydro in off-grid energy supplies in Rwanda. For biogas, the primary barrier that has been identified is demand uncertainty, meaning a reluctance among developers to enter the market or to invest in sufficient scale to bring down costs. The AMC will help address this by increasing the returns to biogas investment, thereby increasing interest and market size. It will pay a cash incentive over 3 years to developers of biogas systems serving community installations such as schools. The micro-hydro incentive focuses on ensuring the sustainability of systems and will be paid against a combination measure including number of households served and of new household connections.

Source: Case study #34: Rwanda—AMCs for Rural Energy.

consumers with ration cards or without existing connections to the distribution system). The size of the subsidy is also carefully determined based on third-party or competitive costing of the works involved and the willingness and ability to pay for surveys. Institutional arrangements such as independent verification agents and funds flow processes are also determined at the planning stage. The World Bank-managed Global Partnership on Output Based Aid (www.gpoba.org) serves as a global center of expertise for OBA design and monitoring.

Output-based disbursement (OBD). OBD involves payment of a subsidy to a service provider or a contractor against delivery of improvements in the efficiency of service-related assets, systems, or recurrent government activities. Unlike OBA, OBD is not targeted at low-income consumers per se.

RBF also includes a range of mechanisms that aim to create sustainable markets by guaranteeing service providers—for a limited period of time—a price on their delivery of a predefined output and/or a minimum number of units that they will be able to sell. This concept was known as Advanced Market Commitments, or AMCs, when it began in the health sector, but is now being applied more widely to the energy and other sectors. Feed-in tariffs, which guarantee the price for RET projects, can be considered a form of AMC.

Payment for Environment Service (PES). PESs are marketlike payment mechanisms where the downstream beneficiaries of environment services (including reductions in carbon emissions) pay for the continued supply of these services by upstream providers. For instance, an entity such as a bottling company pays another party, such as a rural community, a fee to ensure the delivery of reliable and high-quality water supplies. The community would commit to sustainable land and water use activities to meet this requirement. PESs usually involve legal contracts and an administrator who helps design, negotiate, and monitor the agreement.

An example of RBF in action is the use of OBA to promote SHS. The mechanism makes an initial payment on evidence of the ability to deliver (such as approval of a prototype SHS), a further payment on installation of the SHS, and one or more additional payments at later dates dependent on the continuing operation of the SHS. By doing so, the mechanism creates incentives to install rapidly and to specification and to maintain the SHS following the installation. There are tensions between such mechanisms and other financing objectives—notably making payments after installation implies the project company must have some means of funding the up-front capital costs by itself. In some situations, this has acted to spur local credit markets. In Bangladesh, for instance, an OBA approach to SHS installation has been heavily reliant on the development of microcredit. The independent verification involved with OBA and the certainty of payments based on verification of effective installation have been seen as important to giving microcredit agencies confidence to lend for such activity.

RESULTS-BASED FINANCING (PAYMENT AGAINST OUTPUTS)

Uses

- Pays grants or subsidies against the delivery of a specified set of outputs.
- For RET projects, grants and subsidies are used to reduce the costs.

Pros

- Linking payment of grants and subsidies to results creates strong incentives on developers to deliver.
- Availability of local credit to implementing entities is boosted, if the funder of RBF payments is credible.
- Crowding out effects are limited, as developers must still arrange a large part of the up-front financing.

Cons

- The need for up-front financing by the developer means that results-based financing doesn't necessarily overcome financial markets barriers—it may be difficult to obtain loans against expected future payments.
- For small-scale projects, the costs of verification can be extremely high.
- Without careful definition of the required outputs, incentives can be distorted.

Contingent Project Development Grants

One specific form of RBF of particular application to larger RET projects is that of contingent project development grants. RET projects, particularly when the technologies are new and unfamiliar, face significant risks of delays and increased costs of project development due to technological problems and extended permitting and approvals procedures.

BOX 3.11 CONTINGENT PROJECT DEVELOPMENT FUNDING

The GEF provided a $4 million loan to the local utility, CEPALCO, to help fund the development costs of a 1 MW solar PV plant in Mindanao in the Philippines, to be operated in conjunction with a hydro plant, thus greatly improving dispatch control. The project was intended to demonstrate the operational feasibility of this concept in anticipation of a fall in PV panel prices, allowing future projects to adopt the same model without the need for subsidies. To provide incentives for the project to be operated and maintained appropriately, the GEF loan converts to a grant if the project is successfully operated for 5 years.

Source: Case study #8: Philippines—Grid-connected solar PV—Hydro Hybrid Demonstration Project.

Public agencies can provide funding to help defray these costs. If the funding is provided as a loan, which then converts to a grant if the project is successfully implemented, then incentives are created for the developer to pursue rapid implementation of the project. But there are obvious concerns as to how the developer would repay a loan if the project didn't succeed, as well as doubts whether further incentives to reach implementation would be required. An alternative mechanism is actually the reverse, a contingent grant that transforms to a loan if the project is successful. This allows development activities to proceed without the developer taking on loans that they may default on if the project cannot be implemented for reasons outside their control, as well as providing a source of funds through loan repayments that can then be used for future project development grants.

RESULTS-BASED FINANCING (CONTINGENT PROJECT DEVELOPMENT GRANTS)

Uses

- Provides preinvestment funding, either as loans that turn to grants if the project is successful or grants that turn to loans.

Pros

- RBF can leverage private financing by supporting development of projects to a stage where private investors are willing to participate.
- The use of loans that will be converted to grants provides incentives to developers to complete projects in a timely fashion.
- The use of grants that will be converted to loans means developers are more willing to take on marginal projects, knowing that the costs of preinvestment activities are covered if the project is unsuccessful.

Cons

- The use of loans that will be converted to grants increases the risk for developers if the project is unsuccessful.
- The use of grants that will be converted to loans can reduce incentives to complete projects of marginal viability.

3.8 CARBON FINANCING

Advance sales of CERs offer a way for project developers to manage the risks associated with the sales of CERs and, thereby, help mobilize funding. Such sales may be either made on the basis that the purchaser will be responsible for obtaining registration under the CDM (which will reduce the price offered) or that the developer will do so. Various commercial entities are already engaged in such purchases, and the World Bank also administers a number of trust funds for the purposes of purchasing CERs. The Carbon Partnership Facility under the World Bank will further enhance this capability as well be a mechanism for post-2012 funding by providing guaranteed commitments to purchase certified reductions in emissions on a standard basis rather than negotiating individually on a project-by-project basis, as is common at present.

CARBON FINANCING

Uses

- Allows projects to access expected revenue streams from CERs ahead of commissioning or at start of operations.

Pros

- A possible means of obtaining up-front financing secured against carbon revenues (that is, project financing).
- Used to refinance projects, thus freeing up resources for development of new projects.

Cons

- Only a small number of potential buyers of CERs exist.
- Significant risk is transferred to the public financing agencies, if purchases are made ahead of project registration (under the CDM) or if carbon revenues are uncertain.
- Process of realizing carbon revenues can be complex and costly, particularly for first-of-a-kind projects, and reliance on these may delay project development substantially.
- Front-end loading of carbon finance revenues has been difficult to realize in practice given the regulatory and operational uncertainties of these projects.
- Financing only covers a part of costs and amounts received depend on carbon prices.

A risk for any advance purchase of CERs, of course, is that the expected volumes of emissions reductions will not be forthcoming. To manage this, carbon delivery guarantees might be used, covering the losses resulting from actual emissions reductions being less than expected.

3.9 SMALL-SCALE PROJECT FINANCING

This category of financial instruments relates specifically to small-scale RET projects, in particular household and community-level systems for off-grid electrification. Such projects are generally developed by small suppliers and serve low-income communities with limited ability to pay up front. Consequently, they face even greater problems than other RET projects in raising the necessary capital to make initial investments.

The instruments below are more specific to small-scale RET projects, but other instruments can obviously be used to support these as well. In particular, the use of RBF can be effectively combined with appropriate business models to create appropriate incentives for developers. One example of this is the linkage of payment of subsidies for SHS installations to the continued operation of those installations, under an OBA model. This creates incentives for suppliers to provide continued maintenance for these installations to be able to collect the full subsidy.

BOX 3.12 MICROFINANCING OF SOLAR HOME SYSTEMS

The UNEP-supported solar loan program operates in the southern Indian states of Karnataka and Kerala. The program is intended to provide access to affordable microfinance loans for use by poor households to purchase solar home systems (SHSs). The key component of the program is the provision of subsidies to participating banks to reduce the interest rate charged to households. The subsidy takes the form of a grant (typically equivalent to 2-6 months of loan repayments) paid to the borrower at the end of the loan term. The grant is sufficient to reduce the effective interest rate paid while also providing security for lenders—the need to wait for the grant provides an incentive for households to make all repayments, while the bank can retain the grant in the event the household defaults. A payment is also made to banks for each SHS loan concluded, reducing the effective transaction cost.

Source: Case study #12: India—Solar Loan Program.

Microfinancing

One mechanism that has been pursued is that of channeling funds through microfinancing institutions (MFIs) to provide loans to households, either directly or via the equipment supplier, who can then use this to pay for at least part of the capital costs of RET systems. The need to collect repayments also provides an incentive for the supplier to maintain and ensure the continuing operation of the systems postinstallation. MFIs are characterized by their focus on lending to households and small businesses—generally for productive investments (such as cottage industries) or to support agricultural activities (such as the purchase of fertilizers ahead of harvests). Most MFIs have a relatively narrow focus in geographical, product, and sector terms (the well-known Grameen Bank in Bangladesh is somewhat of an exception). Loans are typically made at relatively high interest rates and for short periods, to be repaid from the additional revenues generated by the investment or from the future sale of crops. Longer-term lending for appliances where repayment depends on household incomes, as is the case for the purchase of SHSs, is therefore a change in business model for many MFIs. In Bangladesh RBF has been used in combination with microfinance activity to refinance MFIs after they have been verified to have carried out appropriate installations, thus freeing MFI funds for further lending.

Public financing of such MFI initiatives can be provided through a variety of instruments. These can include the provision of credit lines to increase available funding and lower the costs of customer loans, the provision of grants or subsidies for a similar purpose (often on a RBF approach), or the provision of guarantees to cover MFIs against part of the losses they might sustain from loan defaults—either directly or through the failure of supplied equipment.

MICROFINANCING
Uses
• Provides customers with credit to purchase RET hardware (typically SHS).
Pros
• A means of allowing RET developers to receive payment on installation of systems, reducing need for up-front financing.
Cons
• MFIs may not exist or may be unwilling to lend for purchases of RET hardware, as loan terms are longer than typical MFI loans and repayment is dependent on household incomes rather than revenue generation. • Transactions costs are high, although MFIs are able to reduce these compared to alternative financing arrangements. • Microfinancing still requires RET developers to find significant working capital to fund initial purchases of RET systems ahead of first sales.

Portfolio Guarantees and Loss Reserves

Obviously there are high risks of default in lending to poor rural households for the purchase of electrical systems that do not (directly) increase household incomes. One mechanism for managing this risk is the use of guarantees. As projects of this kind typically involve large numbers of similar individual loans, **portfolio guarantees** or loss reserves are appropriate instruments rather than individual guarantees that might characterize larger RET projects. Portfolio guarantees cover a proportion of the losses on the package of loans (or projects) as a whole. A "first loss" guarantee would cover part of the first tranche of losses—for example, 80 percent of losses up to a value of 10 percent of the portfolio as a whole. A "second loss" guarantee would cover a second tranche of losses—for example, 80 percent of losses between 10 and 30 percent of the portfolio. First loss guarantees provide greater protection to the financier. Second loss guarantees protect against extreme events while also providing strong incentives for the supplier to minimize losses as it bears the first tranche of these. A risk in any such arrangement is that the

PORTFOLIO GUARANTEES AND LOSS RESERVES
Uses
• Guarantee a part of the losses incurred by a portfolio of similar projects in the event of a specified event occurring.
Pros
• By grouping projects, the reserves required against default can be reduced as a result of the diversification of risk compared to individual guarantees, allowing for a greater degree of leverage. • Transactions costs for each project are reduced as any project meeting the required criteria can be included in the guaranteed portfolio.
Cons
• Large number of similar projects are required for this funding to be effective. • Project developers may include inappropriate projects in the portfolio, increasing the risk exposure of public financial agencies. • Ideally requires good database of similar projects to be able to assess risk of guarantee or reserves being utilized. • As with other guarantees, requires good accounting of contingent liabilities and may create scope for abuse. • Sophisticated institutional capacity required to manage such programs.

guarantor has limited control over the loans or projects added to the portfolio. Although standard criteria might be defined, it is very difficult to ensure these are followed in all cases. Again, the recent experience with collateralized debt obligations written against household mortgages in the United States shows the high levels of risk inherent in relying on entities with incentives to maximize the volume of loans covered by such guarantees to determine which loans to include in their coverage.

Loss reserves operate in a similar manner, except in this case the actual sums required to cover the guarantee are set aside rather than simply being a promise to pay if the guarantee is called. Consequently, they provide greater certainty that funds will be available to meet the guarantor's obligations. They also allow for the use of a guarantee without an actual guarantor—the necessary loss reserves can simply be paid into a special account for this purpose at the project's start.

Aggregation

A major barrier to lending to small-scale projects is that of associated transaction costs. These will rule out many RET projects from the commercial financing market, even if they are otherwise attractive. *Aggregation* of projects is one way to overcome this barrier. Various forms of aggregation can be used. One approach is to adopt standard project specifications and agreements so that each individual project can be rapidly appraised at low cost. For example, Sri Lanka and Vietnam have both adopted standard power purchase agreements and tariffs for small hydro projects, avoiding the need for these to be reviewed for each new project. Another is to establish a dedicated financing intermediary that, because of the large volumes of similar transactions it deals with, can realize economies of scale in their appraisal. Such an intermediary could be a public entity or could be a CFI through which loans for RET projects are channeled. The role of intermediaries is discussed below.

AGGREGATION

Uses

- Reduces transactions costs by bundling together similar projects that use standard contracts and specifications.

Pros

- Transactions costs for each project are reduced as the standardization of documentation means rapid review is possible.

Cons

- Large number of similar projects are required for it to be effective
- Commitment on part of developers, offtakers, and financiers is required so they do not amend standard documents.

A summary of the individual financial instruments discussed above, with their pros and cons, is presented in appendix 2.

4 The Role of Financial Intermediaries

At its simplest, there are three main routes for providing public funds to renewable energy technology (RET) project companies:

Direct provision. This represents direct grants, equity contributions, or loans to the project company. The original public financing agency is responsible for due diligence. Funds may be given directly or on-lent by governments, the route for most funds provided by multilateral organizations, such as the International Development Association (IDA) and International Bank for Reconstruction and Development (IBRD) arms of the World Bank Group (WBG).

Through a commercial financial institution (CFI). In this instance, public financing is used to provide a credit line or guarantee for a CFI, which is then responsible for providing funds to RET project companies—whether as grants, loans, or guarantees. The CFI might supplement the public funds with complementary funding from its own resources or blend public and its own funds into a single loan. The CFI is responsible for due diligence, following procedures and processes approved by the public financing agency.

Through a fund or similar vehicle established for the purpose. In this instance, public financing is used to provide the initial capital for the fund, which then provides this to RET project companies. The fund may either be dedicated to RET projects or may have broader remits—for example, to support rural electrification. The fund is responsible for due diligence, following procedures and processes approved by the public financing agency.

This chapter briefly considers the respective merits of using CFIs or funds as intermediaries and provides guidance on the selection between these.

BOX 4.1 USING CFIS AS INTERMEDIARIES IN BURKINA FASO

Isolated grid projects in Burkina Faso are undertaken by local communities who establish electricity cooperatives for this purpose. Funding for investments is provided by the Rural Electrification Fund (REF) with 75-80 percent coming as a direct grant and the remainder as a 10-year loan on concessional terms channeled through rural banks. The bank bears no risk but the expectation is that administering the loan will create an ongoing relationship between the bank and cooperative, so making it willing to extend loans in future. The separation also enables the REF to draw a clear distinction between grants and loans in funding. In practice, there are concerns that the REF has not insisted sufficiently on the need for loan repayments, while the bank itself has no incentives to enforce these repayments. Consequently, the intention of building a track record of reliability with the bank for the cooperative is being lost.

Source: Case study #19: Burkina Faso—Rural Electrification Program.

4.1 COMMERCIAL FINANCIAL INSTITUTIONS

In principle, the use of a CFI is preferred. A CFI usually has existing capabilities in due diligence, borrower appraisals, and the administration of loans and guarantee products. It also has established networks that can be used to identify and work with RET project developers.

BOX 4.2 CHINA'S UTILITY-BASED ENERGY EFFICIENCY PROGRAM (CHUEE)

Under the CHUEE Program, the International Finance Corporation (IFC) provides guarantees to participating commercial banks covering part of the potential losses on energy efficiency loans. The loans are for a maximum duration of 20 years and borrowers must pay at least 20 percent of the costs themselves.

Lending supported by the Program has expanded very quickly, to US$630 Million by December 2010, of which $402 Million was covered by loan guarantees. The Program has helped established an institutional setup for EE lending in partner banks, introducing loan products different from conventional practice based on corporate assets and facilitate access to finance for key market players – ESCOs – through technical assistance for building their capacity and by brokering relationship with banks.

However, according to IEG's Evaluation of the Program, there are areas of improvement to increase the level of additionality. The review found that the Program should have focused more on market segments that did not have access to other forms of energy efficiency finance already in place in China. In particular, it had focused on large enterprises (cement, steel, chemicals factories) rather than the SMEs, housing and commercial buildings that were originally envisaged as targets recipients. IFC has launched in 2011 a new CHUEE SME program targeting EE SME lending only.

Source: Case study #9: China—Utility-Based Energy Efficiency Program.

A CFI may also offer a more sustainable source of intermediation, as its continued existence is not dependent on one particular group of projects or one particular funding source and it may be able to complement public funding from its own financial resources, thus increasing the leverage benefits of public financing.

CFIs may have little or no previous experience in lending to RET projects. In these cases, public funds working with CFIs help them build up their capacity in this area at low cost and limited risk. Subsequently, as the CFI's familiarity with the sector grows, they can increasingly look to exploiting opportunities for commercial lending without the continued need for public funding.

But working through CFIs can also have its problems. One potential risk is that the use of public funds by CFIs will be directed by their own commercial objectives rather than by the wider public policy objectives underpinning the original provision of public funds. While outright redirection or misuse of funds is unlikely, the example of China's Utility-Based Energy Efficiency Finance (CHUEE) Program shows how the conflicting objectives might make public financing less effective than expected (see box 4.2).

CFI procurement and accounting procedures may also not comply with public sector requirements. In this case, much of the advantage of using CFIs to reduce administrative costs may be lost, as the CFIs will need to learn these new procedures and to ensure that lending of public funds follows them—effectively separating these from the CFI's own commercial lending.

Another risk is that CFIs become unnecessarily reckless in their lending, if they only bear a small part of the total risk of default. The CFIs then face a situation where there is a potentially high upside if the project is viable but only a limited downside risk it if defaults. If there is pressure on the CFI to disburse funds rapidly, as is often the case with public financing, then this danger is intensified.

The reverse to this risk is that CFIs will fail to disburse public funds at all. It is possible that they may decide that the limited returns available on lending to RET projects do not justify the additional costs and risks, particularly where they need to develop new skills and institutional capacity to appraise such loans.

Finally, it will inevitably be impossible to involve all potential CFIs in a program of public financing of RET projects. While this can create competition among CFIs to manage such a program, it can also create significant risks of market distortion. Selected CFIs are likely, if the program is working well, to develop skills and experience in RET lending that their competitors cannot match and, consequently, to leave them with significant market power gained, in part, from public funding. The involvement of multiple CFIs in a financing program can mitigate this risk, but at the cost of reducing the resources available to any one CFI, making the program less attractive to them.

4.2 FUNDS AND OTHER SPECIALIZED INTERMEDIARIES

The alternative to using CFIs is to use a fund or other specialized financial intermediary—either an existing fund whose remit includes or can be extended to include RET projects or a new fund established specifically for this purpose. While the use of CFIs is generally preferable, it will frequently be unfeasible. Perhaps the most common reasons are that: (i) CFIs lack interest in lending to RET projects even where public funds are available; (ii) particularly in the smallest economies, CFIs lack the financial and institutional capacity to implement any large-scale lending program using public funds; or (iii) the transactions costs of lending to RET projects—particularly for off-grid systems—are so high as to make lending at any reasonable cost nonviable for CFIs. It is also possible that legal restrictions on the use of public funds by private organizations may force the use of funds, if publicly owned commercial banks do not exist or are not suitable intermediaries.

Where a fund is established, sustainability must be the key consideration. This will argue for the use of an existing fund where possible—as the fund's continuing activity is not then dependent on a single sector or a single source of financing. Where a fund is established specifically to support RET projects then efforts must be made to obtain sources of contributions in addition to the original public financing source. Failure to do so creates a high risk that the fund will largely cease active operations as and when the original financing ends. While structuring a fund on a revolving basis (so that

BOX 4.3 INDIA RENEWABLE ENERGY DEVELOPMENT AGENCY (IREDA)

The IREDA provides an excellent example of a specialized intermediary. It was established as a government-owned corporation in 1987, specifically to finance renewable energy projects. Up to 2003 the IREDA had funded around 30 percent of all RET capacity installed to that date. The IREDA receives funds from a variety of international organizations as well as from the Government of India and its own borrowing (using tax-free guaranteed bonds with a 7–10 year tenor). Its nonperforming loan performance compares well with other Indian lending institutions. In the longer term, it is unclear whether the IREDA can continue to effectively compete with commercial banks entering the RET market or whether it should refocus its activities to that of sourcing wholesale funds to be invested by other intermediaries and to providing risk guarantees.

Source: Case study #7: India—Renewable Energy Development Agency.

repayment of the original principal used to establish the fund is not required and, instead, repayments from RET borrowers are used for future loans) can, in principle, ensure a continuing stream of income, the annual lending capacity is inevitably reduced from the size of the original financial contribution. Unless this original contribution is, therefore, extremely large or it is used to mobilize additional sources of finance channeled through the fund, the loan program of the fund will inevitably shrink substantially.

Government-owned funds also frequently suffer from a lack of institutional capacity. Remuneration is often low compared to that offered by CFIs and opportunities for career progression limited, making it difficult to attract and retain qualified staff. There is also the risk of political interference with the fund's operations, to favor particular developers, technologies, or project locations.

A summary of the pros and cons of using CFIs or specialized funds as financial intermediaries is presented in appendix 3.

5 Selecting the Appropriate Financing Instruments

Although some financial instruments are clearly better than others for addressing specific barriers and risks to scaling up the deployment of renewable energy technology (RET), no simple or mechanical linkage can be made from barrier or risk to instrument and vice versa. More than one instrument may be suitable for addressing an individual barrier or risk, while a single instrument may be able to mitigate or overcome multiple barriers and risks. The barriers and risks are also unlikely to occur in isolation from one another—generally, multiple barriers and risks will exist, and a package of instruments will be needed to address them. The selection of instruments will also depend on the environment within which they are to be implemented and the specific nature of the RET projects concerned.

This paper does not, therefore, attempt to provide a definitive answer as to which instrument to use when—this would be an impossible task. Instead, an illustrative indication of which instruments can be applied to which barriers and risks is provided in appendix 4. That appendix cross-references the individual barriers and risks described in chapter 2 with the financial instruments discussed in chapter 3 (and several of the financial intermediaries discussed in chapter 4). The appendix is an extension of figure 3.1.

Appendix 4 also identifies the case studies (as numbered in appendix 1) that are most relevant for each instrument. Detailed case study write-ups can be accessed at www.worldbank.org/energy/refine.

These case studies are provided as examples of good practice in the use of the instrument concerned. Given that the circumstances of each country and project are unique, it should not be assumed that the case study can be directly applied to any individual situation. Instead, the case studies are intended to illustrate possible approaches that might be followed as a basis for the design of an appropriate instrument. Further literature on individual case studies provides additional information to assist in this process.

6 Making it Work

The best-designed financial instruments will be ineffective in delivering a scaling up of renewable energy technology (RET) deployment if this is not supported by the wider enabling institutional, legal, and regulatory environment. This chapter discusses this wider environment. It is not the intention of this paper to define how this wider environment should look and what steps should be taken to enhance it; these topics are covered in many other sources. Readers are referred, in particular, to the Renewable Energy Toolkit jointly developed by the World Bank and Energy Sector Management Assistance Program (ESMAP). Instead, this chapter looks briefly at the prerequisites for the application of different financial instruments.

6.1 INSTITUTIONAL CAPACITY

Perhaps most obviously, the use of publicly funded financing instruments requires that public agencies have the institutional capacity to manage such instruments in an effective and transparent manner. Institutions must be able to effectively plan and prepare RET projects and programs for support, to implement instruments in a timely manner, and to follow all necessary procedures and regulations (particularly where donor funds are involved).

It may be possible to use commercial financial institutions (CFIs) to deliver the instruments (as discussed in chapter 4). If this is not possible and if existing agencies lack this capacity, it will be necessary to build it—either through support to existing agencies, the creation of new project management offices (PMOs) within existing agencies, or the establishment of new agencies with a specific remit to manage these instruments. The last of these may be the most effective in terms of managing any individual instrument, but is also time consuming and runs the risk of fragmenting institutional arrangements with multiple agencies providing financial support through different instruments using funds from different sources.

In some instances, limitations on institutional capacity may help determine the appropriate instruments to use. Where these limitations are severe and improvement is unlikely or will only take place over a extended period, then it makes sense to bias the selection of instruments toward those that are simplest to implement, and that can be implemented on a one-off basis with external assistance rather than requiring ongoing management by local institutions. For example, a capital grant might be favored as an instrument that can be rapidly delivered, with the help of external advisors working to identify appropriate recipients. Once the grant has been made, of course, it is no longer necessary for public agencies to continue to administer it. But they would be expected to monitor the performance of RET projects receiving the grant, to gather evidence on its effectiveness and to help design future interventions.

An underlying assumption of this paper is that a basic level of institutional capacity exists. In the smallest and most fragile states, this may not be the case. Institutions may have limited functionality and may lack competent staff—or, indeed, any staff. In such cases, rapid adoption of financial instruments to support scaling up RET deployment is unlikely to be effective. Instead, initial efforts and external financial support should be directed to building up capacity to a level where domestic institutions can manage a limited program of support to RET projects and programs.

BOX 6.1 POLICY FAILURES IN HONDURAS

In June 2007 the president of Honduras declared an "energy emergency." Inadequate generating capacity, growing demand, a reliance on imported oil and diesel at a time of rising prices, high levels of system losses, and tariffs below costs all combined to leave the state utility, Empresa Nacional de Energía-Eléctrica (ENEE), unable to meet demand, even as it was losing money at an unsustainable rate. An intervention board was created, headed by the ministers of finance and defense, and a new energy commission to direct policy was established in 2008.

The crisis had multiple causes, but a significant contributing factor was the failure of the policy and regulatory framework to deliver clear and consistent outcomes. Policy making in principle was undertaken by the relevant ministry and an Energy Cabinet, while regulation was the responsibility of an independent agency, Comisión Nacional de Energía (CNE). In practice, the lack of technical capacity and resources in both the Cabinet and CNE, and a lack of political commitment to CNE, led to ENEE being the de facto planner and advisor for the power sector. While private investment in generation did occur, delays in contracting, uncertainties in policy making, and the inability to raise tariffs to cost-reflective levels also led to developers favoring diesel generation, which could be installed rapidly, had low capital costs, and could be redeployed if necessary, despite the abundant renewable energy resources in Honduras. Reliance on such high-cost generation was, of course, one of the reasons for the ENEE's financial crisis.

Source: Honduras Energy White Paper, Institute of the Americas (2009); Honduras Power Sector Issues and Options, ESMAP (2010).

6.2 POLICY AND PLANNING FRAMEWORK

The use of publicly funded financial instruments to support large-scale deployment of RET needs to be underpinned by an effective policy and planning framework. Without this, there is a high risk of funds being directed to ineffective or wasteful uses.

An effective policy and planning framework will identify which RETs are to be pursued, based on analysis of the relative costs and resource availability, the potential for scaling up, and identification of priority technologies.

Projects for support will be well defined and realistic. Support will be coordinated and duplication of effort avoided where possible (for example, where multiple competing public and donor-funded activities exist side by side). The activities of different domestic institutions will similarly be coordinated to avoid overlaps and gaps. This may be particularly challenging where responsibilities for RET projects are split between national, regional, and local levels.

An accompanying regulatory framework needs to be put in place. In particular, this will emphasize the use of appropriate support mechanisms for RET projects.

6.3 SUPPORT MECHANISMS

Support mechanisms for RET projects take many forms. For the purposes of this paper, discussion is limited to the use of mechanisms designed to ensure access to a viable market for these projects. Without this access any financial instrument is unlikely to be effective as it cannot, on its own, overcome the inherent cost disadvantage of RETs.

On Grid

The key barrier to RET projects in accessing markets is their higher costs relative to other technologies. There are two basic mechanisms to delivering subsidies to RET projects to overcome this cost disadvantage.[6] The first is to pay RET projects a guaranteed feed-in-tariff (FIT) set at a level adequate to recover their costs (generally on a technology-by-technology basis). To ensure that projects are able to sell their output at this tariff, they are given priority dispatch rights and a must-take obligation is imposed on power purchasers, requiring them to buy output from RET projects.

The second basic mechanism is the use of a renewable portfolio standard (RPS). In this case, energy suppliers are obliged to purchase a minimum share of their needs from RET sources. Failure to do so attracts a penalty, common across technologies.[7] The existence of this penalty allows RET projects to charge a higher price than other technologies and still be competitive, as long as the share of RET output remains below the minimum established under the RPS.

There are obviously many variants on and combination of these basic mechanisms. In general, the experience has been that FITs are more effective at mobilizing RET investment but can also be significantly more expensive as there is no limit on the quantities of RET capacity added to the system and, therefore, the total costs incurred under the mechanism. This has been a problem in recent years in a number of European countries including Germany, Spain, and the Czech Republic, which have all been forced to reduce the level of FITs offered to solar projects in particular due to affordability concerns. The use of a RPS avoids this problem

BOX 6.2 BIOENERGY FEED-IN TARIFFS IN SRI LANKA

Sri Lanka has set a target of 10 percent of grid electricity to be supplied from RET sources by 2015. In support of this, a three-tiered feed-in technology-specific tariff for electricity sold to the state utility, the Ceylon Electricity Board (CEB), was introduced in 2008. The CEB has an obligation to purchase all power sold from RET sources with the difference between its own costs and the FIT being made up by the government.

To date, only two significant biomass projects totaling 12 megawatts (MW) have been developed under the FIT. The first grid-connected biomass project in Sri Lanka is no longer operating. This is reportedly because it was unable to take advantage of the FIT due to the slowness of the administrative process to approve this.

But there has been more success with small hydro and wind projects. Sri Lanka has two decades of experience with small hydro projects and there are now well-developed market chains in place. Wind projects, meanwhile, benefit from a high FIT and the interest of a number of Sri Lankan corporations. As and when experience and domestic interest develops in biomass projects, similar success may be seen. The experience to date demonstrates the importance of the wider environment and the inadequacy of setting a FIT alone.

Source: Case study #17: Sri Lanka—Renewable Energy.

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6 In some countries, RET projects receive a tariff based on the avoided costs of the electricity utility, which may or may not include an allowance for carbon costs and other environmental damages. This is not considered to represent a subsidy to RET projects as it does not compensate them for costs above those of other technologies and is not discussed further in this paper.

7 This has proven to be a concern in the United Kingdom, as it inevitably leads developers to focus on the lowest-cost RET (onshore wind). While this is an efficient outcome, it runs contrary to government objectives to promote a range of RETs. This has been addressed by providing extra credits under the RPS for higher-cost RETs, which are then able to earn additional revenues by selling these credits at the penalty price.

but can lead to unit costs that are higher than FITs, as the subsidy provided is not as well targeted, and so low-cost RET projects can earn the same subsidies as higher-cost projects. There is also the problem of the "cliff-edge" effect where, as the level of RET output nears the RPS requirement, the value attached to purchasing additional RET output collapses to zero. In some cases, FITs have been combined with a quota on the quantity of RET generation eligible for these tariffs, but this requires some mechanism to efficiently allocate the rights to participate in this quota.

There are also additional requirements if these mechanisms are to be effective in their application. Most obviously, the purchasers or off-takers of output from RET projects must be sufficiently creditworthy to credibly commit to the additional costs of these purchases compared to conventional technologies. This may require further financing mechanisms to be put in place, such as levies on electricity customers, which can be used to compensate off-takers for these additional costs. Additionally, these mechanisms rely heavily on the concept of priority dispatch for RET projects, which means that these projects must have guaranteed access to transmission and distribution networks, if such priority dispatch is to be meaningful. As many RET projects are located in remote areas, the costs of providing such guaranteed access can be considerable and, if recovered from RET projects alone, may well make them nonviable. In such cases, mechanisms to fund the necessary network extensions and reinforcements from other sources, including electricity customers generally, will be required.

Off Grid

For off-grid RET projects, the need for support mechanisms is somewhat different. High costs remain a barrier and can be overcome through well-designed grants and subsidy mechanisms. Small market sizes and project scales are also barriers that can be mitigated through well-designed financial instruments, including through aggregation and potentially the use of results-based financing (RBF) instruments such as those that attempt to mimic Advanced Market Commitments (AMCs). But there are other barriers that financial instruments cannot effectively address. In particular, these include the need to ensure that off-grid supplies are not overtaken by grid extension. Where grid extension is likely to take place, the effects are twofold. Potential users of off-grid RETs will prefer to wait for the grid, which is generally seen as a superior technology. And where investments are made in off-grid RET equipment, then this may become "stranded" if the grid reaches that location acting as a significant deterrent to suppliers and users to invest in this equipment.

For household-level systems, in particular, a further barrier that cannot be directly addressed through financial instruments is uncertainty over the safety and longevity of RET equipment. This uncertainty can lead to potential users being unwilling to make large payments for equipment—particularly where they are unable to tell apart low- and high-quality equipment. The regulatory framework can help to overcome this by setting and verifying technical specifications for equipment. RBF systems that require appropriate warranties from suppliers as one of the "outputs" used to trigger a payment have also worked effectively.

7 References and Further Reading

Please refer to www.worldbank.org/energy/refine for an up-to-date list of references and further reading. This Web site can also be accessed for full write-ups of case studies and financial instruments.

Appendix 1 List of Initial Case Studies

REFERENCE	TITLE
1	Thailand—Energy Efficiency Revolving Fund
2	Ukraine—Sustainable Energy Lending Facility
3	Central America—E+Co CAREC Mezzanine Finance Fund
4	Macedonia—Sustainable Energy Financing Facility
5	Uganda—West Nile Rural Electrification Project
6	Nepal—Power Development Project
7	India—Renewable Energy Development Agency
8	Philippines—Grid-connected Solar PV—Hydro Hybrid Demonstration
9	China—Utility-based Energy Efficiency Finance Program
10	Hungary—GeoFund
11	Uruguay—Wind Energy Program
12	India—Solar Loan Program
13	Bangladesh—Solar home program on Credit Sales
14	Africa—Africa Carbon Support Program
15	Sri Lanka—Power Fund for the Poor
16	Rwanda—AMCs for Rural Energy
17	Sri Lanka—Renewable Energy
18	Asia—ADB Clean Energy Private Equity Investment Funds
19	Burkina Faso—Rural Electrification Program
20	Egypt—NREA Wind Farms Financing
21	Central and Eastern Europe—Commercializing Energy Efficiency Finance (CEEF)
22	Thailand—Biomass Generation and Cooperation
23	Chile—Chilean Economic Development Authority Credit Lines
24	Philippines—Leyte Geothermal Partial Credit Guarantee
25	China—Wind Reinsurance Facility for China
26	Global—insurance4renewables
27	India—ICICI Securitization of SHARE Micro-Credits
28	Global—Carbon Partnership Facility
29	India—IFC Rain CII Carbon Ltd
30	Tunisia—Solar Water Heating Equipment Finance Program
31	Indonesia—Small Hydropower
32	Bolivia—SHS Medium-Term Service Contracts
33	Laos—Nam Theun 2 Project

Appendix 2 Summary of Financial Instruments

INSTRUMENT	USES	PROS	CONS
Grants			
Capital grants	Reduce project costs and provide long-term finance.	Relatively simple to implement. Does not require ongoing administration.	High risk in terms of achieving objectives as they do not create incentives for delivery. If grants are made in return for equity then the public sector gets control of the projects, which may lead to poorer performance and crowd out private financing. Low levels of leverage as grants directly replace possible private financing. No return on capital that could be used to finance further projects.
Project preparation grant	Fund preinvestment costs.		
Equity			
Venture capital	Funds preinvestment costs as risk capital.	Can pay for itself. Potential gains to be realized are a strong incentive for project viability.	High returns are required to compensate for risk. Although public financing can accept lower returns, it reduces incentives and makes it harder for private providers of equity to compete. Low levels of leverage as it directly replaces possible private financing. Developed financial markets are needed to allow exit from the investment through an initial public offering (IPO) or a direct sale of shares.

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INSTRUMENT	USES	PROS	CONS
Debt			
Senior debt	Reduces project costs. Provides long-term finance.	Obligation to repay creates incentives for project viability. Repayment of principal frees funds for further support to renewable energy technology (RET) projects. Can be used as a means to increase commercial financing institution (CFI) involvement in RET projects (through provision as credit lines).	Need for due diligence to verify ability of project to repay loan increases transaction costs. Leverage is limited and may crowd out potential private providers of debt.
Subordinated debt (mezzanine finance)	Provides intermediate funding between equity and senior debt, which is able to reduce risks to senior lenders while not taking control away from project sponsors. By doing so, the term can be extended and costs of senior debt reduced.	High level of leverage. Can crowd in senior debt by allowing projects to meet acceptable risk criteria for lenders.	Generally custom designed for each project, implying high transaction costs. Significant risk is transferred to public financing agencies but with only limited ability to control these risks.
Asset-backed securities			
Asset-backed securities	Project financing through bond offerings rather than loans. Refinancing of wwcompleted projects to free public funds for future RET project development.	Longer tenor and possibly lower cost than bank financing. Ready means to refinance projects, freeing developer funds for further investments. Potential to bundle projects together in a single security can reduce risks and, therefore, financing costs. A good industry for advancing capital markets, given that some RETs have guaranteed off-take and hence lower risk.	Sophisticated markets are required to be able to analyze and price the risk associated with this type of security.

INSTRUMENT	USES	PROS	CONS
Guarantees and insurance			
Individual guarantees	Guarantee a part of the losses incurred by a project in the event of a specified event occurring.	Specific risks deterring private investment can be targeted, thereby minimizing the risk of market distortions and being an effective means of crowding in private investment. A high degree of leverage can be achieved as a relatively small commitment of funds can mobilize significant quantities of private investment. Lack of need to make a large up-front payment can make it easier to obtain political approval.	Generally custom designed for each project, implying high transaction costs. Significant risk is transferred to public financing agencies but with only limited ability to control these risks. Appropriate accounting for and approval of the resulting contingent liabilities is required, which may be complicated by difficulties in assessing the associated risks. Ability to avoid up-front funding may encourage excessive use of guarantees for political reasons and for favored projects.
Liquidity guarantees	Guarantee ability to meet commitments on debt service/financing.		
Political risk insurance (PRI) / partial risk guarantee (PRG)	Guarantee of policy and regulatory commitments by host government.		
Resource insurance	Insures against lost revenue in event of lower-than-expected output due to lack of wind or sun (wind / solar insurance). Insures against costs of failed exploratory wells (contingent risk insurance for geothermal projects).	Can be targeted on specific risks deterring private investment, thereby minimizing the risk of market distortions and being an effective means of crowding in private investment. A high degree of leverage is achieved as a relatively small commitment of funds can mobilize significant quantities of private investment.	Large number of projects with diversity of locations is required for the insurer to be able to diversify their risk exposure away from any one project. Large database of historic performance for insurers to be able to assess and price risks. For these reasons, it either needs multinational insurers or large and sophisticated domestic financial markets combined with large volumes of existing RET projects.

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INSTRUMENT	USES	PROS	CONS
Results-based financing (RBF)			
Payment against outputs	Pay grants or subsidies against the delivery of a specified set of outputs. For RET projects, grants and subsidies are used to reduce the costs.	Linking payment of grants and subsidies to results creates strong incentives on developers to deliver. Crowding out effects limited, as developers must still arrange a large part of the upfront financing.	The need for upfront financing by the developer means that RBF doesn't necessarily overcome financial markets barriers and it may be difficult to obtain loans against expected future grant payments. For small-scale projects, the costs of verification can be extremely high. Without careful definition of the required outputs, incentives can be distorted.
Contingent project development grants	Provide preinvestment funding, either as loans that turn to grants if project successful or grants that turn to loans.	Can leverage private financing by allowing development of projects to a stage where private investors are willing to participate. Use of loans that can be converted to grants provides incentives to developers to complete projects in a timely fashion. Use of grants that can be converted to loans means the developer is more willing to take on marginal projects, knowing that the costs of preinvestment activities are covered if unsuccessful.	Use of loans that can be converted to grants increases risks to developers if the project is unsuccessful. Use of grants that can be converted to loans can reduce incentives to complete projects of marginal viability.

INSTRUMENT	USES	PROS	CONS
Carbon financing			
Carbon financing	Allows projects to access expected revenue streams from Certified Emissions Reductions (CERs) ahead of commission-ing or at the start of operations.	Means of obtaining up-front financing secured against carbon revenues (that is, project financing). Used to refinance projects, thus freeing up resources for development of new projects.	Only a small number of potential buyers of CERs exist. Transfers significant risk to the public financing agencies if purchases are made ahead of project registration (under the Clean Development Mechanism, CDM) or if carbon revenues are uncertain. Process of realizing carbon revenues can be complex and costly, particularly for first-of-a-kind projects and reliance on these may delay project development substantially. Financing only incremental cost.
Small-scale project financing			
Microfinancing	Provides customers with credit to purchase RET hardware (typically solar home systems, SHS)	Allows RET developers to receive payment on installation of systems, reducing need for up-front financing	Microfinance institutions (MFIs) may not be operational or may be unwilling to lend for purchases of RET hardware as loan terms are longer than typical MFI loans and dependent on household incomes rather than revenue generation for repayment Transactions costs are high, although MFIs are able to reduce these compared to alternative financing arrangements Still requires RET developer to find significant working capital to fund initial purchases of RET systems ahead of first sales

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INSTRUMENT	USES	PROS	CONS
Portfolio guarantees and loss reserves	Guarantee a part of the losses incurred by a portfolio of similar projects in the event of a specified event occurring	By grouping projects, the reserves required against default can be reduced as a result of diversification of risk compared to individual guarantees, allowing a greater degree of leverage Transactions costs for each project are reduced as for any project meeting the required criteria can be included in the guaranteed portfolio	Large number of similar projects is required to be effective Project developers may include inappropriate projects into the portfolio, increasing the risk exposure of public financial agencies Ideally requires good database of similar projects to be able to assess risk of guarantee or reserves being utilized As with other guarantees, requires good accounting of contingent liabilities and may create scope for abuse Sophisticated institutional capacity required to manage such a program
Aggregation	Reduces transactions costs by bundling together similar projects that use standard contracts and specificationsw	Transactions costs for each project are reduced as the standardization of documentation means rapid review is possible	Large number of similar projects required for it to be effective Commitment on part of developers, off-takers, and financiers is required not to seek to amend standard documents

Appendix 3 Summary of Financial Intermediaries

INTERMEDIARY	MAIN FEATURES	PROS	CONS
Commercial financial institutions (CFIs)	Public funds are channeled through one or more CFIs. CFIs are responsible for due diligence and management of funds.	Existing capabilities in due diligence and administration of loans and guarantees products. Established networks to identify and work with project developers. Can complement public funding from its own financial resources, thus increasing leverage. Can be used to build up CFI experience with renewable energy technology (RET) projects.	Use of funds driven by CFI commercial objectives, not public policy objectives. Procurement procedures may not meet public sector requirements. CFIs may make overly risky investments as their share of losses is limited. CFIs may not disburse funds due to high associated costs and risks/ Can distort the market by favoring some CFIs over others.
Specialized funds	Public funds are channeled through a government-owned specialized intermediary. The intermediary may be specifically established to promote RETs or have a more general remit (for example, electrification).	May be only means to overcome lack of CFI interest. Can develop specialized skills in RET project appraisal and financing.	Sustainability is problematic—particularly if dependent on a single time-limited financing source. Difficult to attract and retain qualified staff. Risk of public interference. Potential crowding out of CFIs.

Appendix 4 Financing Instruments Appropriate for Addressing Financing Barriers and Project Risks

(and Numbers of Pertinent Case Studies from Appendix 1)

Financing instruments	FINANCING BARRIERS					PROJECT RISKS				
	Lack of long-term financing	Lack of project financing	High and uncertain project development costs	Lack of equity finance	Small scale of projects	High financial cost	High exposure to regulatory risk	Uncertainty over carbon financing	High costs of resource assessments	Uncertainty over resource adequacy
Grants										
Capital grants	✓	✓		✓		✓				
Project preparation			✓		✓	✓			✓	✓
Equity										
Venture capital		✓	✓(18)	✓(18)						✓
Debt										
Senior debt	✓ (1, 2, 6, 20)	✓ (1, 2)				✓				
Subordinated debt (mezzanine finance)	✓ (3, 4)	✓ (3, 4)	(3)	✓(3)						
Asset-backed securities										
Asset-backed securities	✓(27)	✓(27)		✓						
Guarantees and insurance										
Individual guarantees	✓(21–24)	✓(9, 23)		✓(21, 23)		✓	✓		✓	✓
Liquidity guarantees	✓(5)	✓					✓			✓
Political risk insurance / Partial risk guarantee	✓	✓		✓		✓	✓(33)			

	FINANCING BARRIERS					**PROJECT RISKS**				
Financing instruments	**Lack of long-term financing**	**Lack of project financing**	**High and uncertain project development costs**	**Lack of equity finance**	**Small scale of projects**	**High financial cost**	**High exposure to regulatory risk**	**Uncertainty over carbon financing**	**High costs of resource assessments**	**Uncertainty over resource adequacy**
Resource insurance									✓(10)	✓(11, 25, 26)
Results-based financing										
Payment against outputs		✓				(32)	✓			
Contingent project development grants			✓(8)				✓		✓	
Carbon financing										
Carbon financing				✓		✓		✓(14, 28, 29)		
Small-scale project financing										
Microfinancing				✓(16)	✓(12, 13, 15, 16)	✓(12, 13, 15, 16)				
Portfolio guarantees and loss reserves	✓	✓		✓	✓	✓	✓			✓
Aggregation					✓(17, 30, 31)	✓				
Financial intermediaries										
CFIs	(17, 19)				(17)					
Funds	(7)				(7)					

Source: Authors.