Promoting energy access through Results-Based Finance within the framework of the CDM: Assessing business models

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CARBON LIMITS

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List of Acronyms

BAU	Business As Usual
CDM	Clean Development Mechanism
CER	Certified Emissions Reduction
Ci-Dev	Carbon Initiative for Development
CPA	Component Project Activity
EB	Executive Board (of the CDM)
ERPA	Emissions Reduction Purchase Agreement
ESMAP	Energy Sector Management Assistance Programme
GHG	Greenhouse Gas
GoB	Government of Bangladesh
GoE	Government of Ethiopia
IFC	International Finance Corporation
IRENA	International Renewable Energy Agency
kW	Kilowatt
MRV	Monitoring, Reporting and Verification
NGO	Non-Governmental Organisation
PIN	Project Information Note
PO	Participating Organisation
PoA	(CDM) Programme of Activities
PPP	Public-Private Partnership
PV	Photovoltaic
RBF	Results-Based Financing
SB	Standardized Baseline
SME	Small and Medium Enterprise
SSC	Small Scale CDM
UNFCCC	United Nations Framework Convention on Climate Change
W	Watt

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Note that this report considers CDM Executive Board decisions up to EB86 (October 2015).

EXECUTIVE SUMMARY

While universal access to modern energy services is a widely acknowledged global development goal, and the Clean Development Mechanism (CDM) has included methodologies to address most of the key energy access technologies, the impact of CDM on energy access to date has been very small. The objectives of this study, commissioned by the Carbon Initiative for Development (Ci-Dev) administered by the World Bank Group are to:

- Identify elements of viable and successful business models needed to promote energy access projects through results-based finance (RBF) to be delivered through the purchase of Certified Emission Reductions (CERs) under the CDM (called in short "CDM RBF"); and
- Identify reforms of CDM regulation required to facilitate the support of such energy-access investments by the CDM including through an RBF approach, as well as broader opportunities within climate finance to utilize RBF approaches for energy access.

Results-Based Financing (RBF) is the payment for various development outcomes by a funder (often called the "principal) contingent upon the delivery of an agreed set of results by a recipient (often called the "agent"), with those results being subject to independent verification. Because the contracts between buyers and sellers of CERs have almost always specified that most of the payment was contingent upon the delivery of CERs, these contracts are also a form of RBF. However, RBF approaches may encompass a wider range of verified results (i.e. non-greenhouse gas (GHG) development benefits), a wider range of payment structures, and could include retirement of the CERs by the buyer instead of using them as an "offset" against their emissions reduction obligations.

The **elements of successful energy access business models** can be broadly classified into four areas:

- *Enabling environment*: the external market framework for the sector, including regulations, policies, institutions, standards and testing facilities, and consumer awareness.
- *Cost structure and cash flows*: the key revenues and costs for delivering energy services, which are impacted by product cost, targeted subsidies, access to consumer financing, supply chain financing, and access to affordable fuel sources.
- *Efficiency and structure*: management capacity, distribution channels and network, collection systems, consumer mix, operational efficiency.
- *Access to capital:* corporate financing for growing businesses to create larger impact.

CDM RBF can address many of the key elements for successful business models, with strongest direct impact on "cost structure and cash flows" (e.g. through the payment of direct incentives), and the standards and consumer awareness aspects of the "enabling environment" (e.g. by requiring that projects meet certain technical standards to qualify for payments). Successful use of RBF incentives relies on strong intermediaries, local financing institutions, or supply chain financing that can bridge the gap between the time of investment and receipt of the incentive. RBF programmes need to identify and partner with institutions that can play these roles. Using a mix of payment milestones can also reduce the financing gap, as well as using incentives to directly support maintenance, after-sales service, and warranty enforcement. Disseminating best practices in business models, and the use of some of these practices as eligibility criteria, could incentivise business model innovations and so positively impact the “efficiency and structure” success factors.

While CDM RBF would primarily use CERs as the verified result against which payments are made, there is a clear trend in climate financing to include additional metrics for performance other than GHG reductions. For energy access, this could be the usability of the energy services (i.e. hours of availability, reliability, affordability) or actual energy consumption levels. A key benefit of the CDM system is that it can provide credible long term monitoring, reporting and verification (MRV) for RBF schemes, at least for quantifying GHG impacts.

In terms of pricing approaches for CDM RBF, auctions have distinct advantages for price discovery, particularly when compared to the transaction costs and capacity needed for an administrative approaches to pricing. However, certain administrative pricing approaches, such as estimating the costs of overcoming specific barriers or funding catalytic components of the overall programme, could provide an alternative that could be both cost-effective for funders and transformative for energy access markets. Administrative pricing also provides an opportunity for valuing non-GHG benefits and paying for multiple results by energy access programmes. Where non-GHG indicators are included as the basis for performance-based incentives, these may also require a baseline similar to what CDM methodologies provide for GHG emissions. Linking CDM RBF pricing to other markets (e.g. trading exchanges for emission reduction commodities or other markets for social and environmental goods) can also work well, as long as these markets are well defined and robust.

For CDM RBF mechanisms to be effective, however, the CDM process must not only provide a trigger for payments, but do so in a timely and transparent manner. An incentive that is uncertain or delayed, even when the energy access goals may have been achieved, would undermine the entire CDM RBF scheme. This is why simplification and streamlining of the CDM can have a positive influence on the success of CDM RBF instruments. CDM reform therefore targets the “cost structure and cash flow” element of successful energy access programmes, by reducing the transactions costs and time required to deliver CERs, as well as reducing the uncertainty associated with CER generation and potentially increasing the cash flows (i.e. if CER generation per household increases).

Expanding and simplifying the standardized baselines (SB) framework could support the increased use of carbon financing by energy access programmes, and reduce the transactions costs and time required to deliver CERs for a CDM RBF programme. Experience in least developed countries shows that data availability is often a problem. Proposing default values for common parameters that could be applied globally and/or by specific Designated National Authorities (DNAs) in their country would therefore make SBs more accessible in these countries. Recognizing existing national data on energy access, for example household survey data, as well as using official international sources, would also reduce the time and cost for SB approval. Incorporating the concept of “minimum service levels” into the SB approval process, with appropriate guidance on how to apply this concept, as well as allowing the use of service *quality* (i.e. not just quantity) to distinguish among potential baseline alternatives would simplify the SB process while robustly quantifying results.

Creating a standardized registration process and, for Component Project Activities (CPAs), a standardized inclusion process for activities considered automatically additional under the current rules would allow many energy access programmes to generate CERs more quickly and with lower transaction costs. The simplified process would eliminate the detailed validation step by a Designated Operational Entity (DOE) prior to registration, and substitute a simple checklist for determining eligibility, which the UNFCCC Secretariat would review as part of the standard completeness check. The projects would be registered on this basis, and all of the project characteristics and performance would be confirmed by a DOE during the first verification. Because no CERs would be issued until after first verification, such a change would not compromise the environmental integrity of the CDM. It would, however, dramatically reduce the transaction costs and time required to get to registration (e.g. 6 months instead of 2 years or more) – so that projects could start generating CERs earlier. The early registration could also reduce uncertainty for investors and RBF funders, and could increase the total revenue that projects can earn.[1] The registration of the overall Programme of Activity (PoA) would remain the same, with a full validation by a DOE. Safeguarding the environmental integrity of the CDM would require regularly reviewing the automatic additionality provisions that would allow certain project types and locations to access this simplified process.

Building on the recent CDM Executive Board actions to simplify the CDM MRV process would also reduce transaction costs and the uncertainty associated with generating CERs. This could be done, for example, by collecting data at a sectoral level rather than only as the facility-level, possibly in cooperation with other actors and associations in the sector. Aggregated monitoring at a sectoral level instead of for each PoA individually could further reduce transaction costs and actually increase accuracy. Revising the magnitude and timing of registration and issuance fees could improve cash flows for energy access programmes, particularly in the current depressed carbon market.

Pre-issuance of a portion of CERs could bring forward the cash flows for energy access programmes and reduce the time required to recoup their investment, which would in turn reduce the need for upfront capital from other sources. The concept would be to issue a percentage of the expected first monitoring period CERs at registration, instead of waiting until after verification to issue any CERs. The percentage of CERs brought

[1] For an improved cook stove with a life of 8 years, for example, under the current system a delay of 2 years to reach registration, when implementation may have already started, could mean the loss of a quarter of the lifetime carbon revenue.

forward by a year (or more) could relate to the historical performance of that technology under the CDM. After the first verification, the remainder of the CERs for that period could be issued, plus a share of the expected CERs from the following period. To safeguard environmental integrity (i.e. minimise the risk of issuing CERs for mitigation that never occurs), the pre-issuance practice could be restricted to technology areas where the risk that the project will *not* continue to operate as planned is low, or the share of pre-issuance could be reduced to account for increased risk of non-performance in a particular technology area. A share of CERs could also be kept in a "buffer account", similar to what has been discussed for afforestation and reforestation projects, to mitigate the risk that emissions reductions will not be achieved. Note that pre-issuance is similar to pre-financing of CER purchases, except that pre-financing is dependent on each buyer's preferences while pre-issuance could apply to projects irrespective of the CER buyer. Because pre-issuance introduced additional risks, however, (since the "result" has not yet been achieved), partial up front financing would be the preferable approach to reducing the project owner's need for capital.

Moving beyond the current CDM rules to explore sectoral or aggregated crediting for energy access programmes could overcome the barriers of high transaction costs and uncertainty under the CDM, and also expand the range of activities that could receive support. To broaden the scope of the CDM to a sectoral level, however, new methodological approaches are needed. The practical challenges will be establishing a baseline for the consumption at an aggregate level and finding a way to capture the diversity of household access levels and previous energy use patterns in a highly aggregated measure of access. Even though this is not currently possible under the CDM rules, RBF funders could propose such approaches using their own pipeline of projects as case studies of the options for setting these more aggregated baselines and emission reduction calculations. For these approaches to remain within the CDM rules, however, they would need to maintain the same level of rigor demanded by project and programme-based CDM. Alternatively, the approaches could form part of a modified or new crediting mechanism.

As one strategy for addressing the access to capital required by successful energy access business models, CDM RBF funders can front-load payments in Emissions Reduction Purchase Agreements (ERPAs). While there are some examples of linking project finance to delivery of CERs, carbon finance has not traditionally provided significant upfront capital for energy access programmes. For activities with lower risk of non-performance, more of the payments could be shifted earlier in the project life. This could accelerate the energy access investments while still keeping operational incentives. RBF funders could consider whether a modest share of the value of the carbon revenue could be paid early in the project cycle (e.g. at registration), following the earlier example of World Bank carbon funds.

Financial instruments that specifically address upfront capital requirements are crucial to address this success factor for growing energy access businesses. Equity investment funds and structured financing tools could be packaged with CDM RBF schemes, so that recipients of performance-based payment contracts might qualify to receive other forms of capital financing. The role of donors in reducing risk in these funds, and “crowding in” private capital is essential.

One avenue for bundling these complementary instruments, including the financing instruments, is to do so under the umbrella of national or sectoral mitigation progammes, such Nationally Appropriate Mitigation Actions (NAMAs) in the UNFCCC or simlar instruments that could emerge from the negoations on a new climate change agreement this year in Paris. These could encompass both CDM RBF instruments in the energy access sector as well as other elements such as capacity building, regulatory support, and provision of project and corporate financing to energy access businesses. **The operationalisation of the new larger scale climate financing channels, such as the Green Climate Fund (GCF), could represent a substantial new source of support** for broad sectoral energy access programmes and for a range of RBF initiatives for energy access.

1. Introduction

Results-Based Financing (RBF) is the payment for various development outcomes by a funder (often called the "principal) contingent upon the delivery of an agreed set of results by a recipient (often called the "agent"), with those results being subject to independent verification (ESMAP, 2013). The Clean Development Mechanism (CDM) system provides independently verified units (certified emissions reductions – CERs) that represent quantified, UNFCCC-certified climate change mitigation. Because the contracts between buyers and sellers of CERs have almost always specified that most of the payment was contingent upon the delivery of CERs, these contracts are also a form of RBF[2]. However, RBF approaches may also encompass a wider range of verified results (i.e. non-greenhouse gas (GHG) development benefits) and wider range of payment structures. In addition, where most buyers of CERs until recently used them as an "offset" against their emissions reduction obligations, the collapse of the carbon market and lack of agreement on a future climate policy regime mean that some current buyers are considering "retiring" these credits instead of using them for compliance, which has implications for pricing and contract structures. Therefore, the phrase "CDM RBF" in this report refers to a funding programme that, while it uses the CDM system for verifying GHG emissions reductions, has the following key differences:

- a broader set up objectives, including crowding-in private sector investment for mitigation and catalysing transformational change;
- a wider range of contractual options between principal and agent, such as consideration of other results and alternative payment structures; and
- retiring CERs instead of using them for compliance or for other types of offsets.

While universal access to modern energy services is a widely acknowledged global development goal, and the CDM has included methodologies to address most of the key energy access technologies, the impact of the CDM on energy access to date has been very small. Among CDM project activities, close to 70 projects address energy access, with just under 2 million CERs projected per year, which is only 0.1% of expected CERs (Fenhann, 2015a). This includes cook stoves, off-grid solar technologies, other renewable energy mini-grids and grid extension. With the advent of Programmes of Activities (PoAs) more focus has shifted to energy access, although the total impact remains small. As of May 2015, 71 energy access PoAs were in the pipeline (i.e. at validation or beyond), with projected CERs of more than 10 million per year from the Component Project Activities (CPAs) included so far, or approximately a third of the PoA pipeline (Fenhann, 2015b). Given that PoAs can grow to many times the size of the initial CPA with which they are registered, this is a significant increase in scale, but remains far from the goals of the international community, as set forth in the "Sustainable Energy for All" programmes, of reaching the hundreds of millions of people without access to modern energy services.

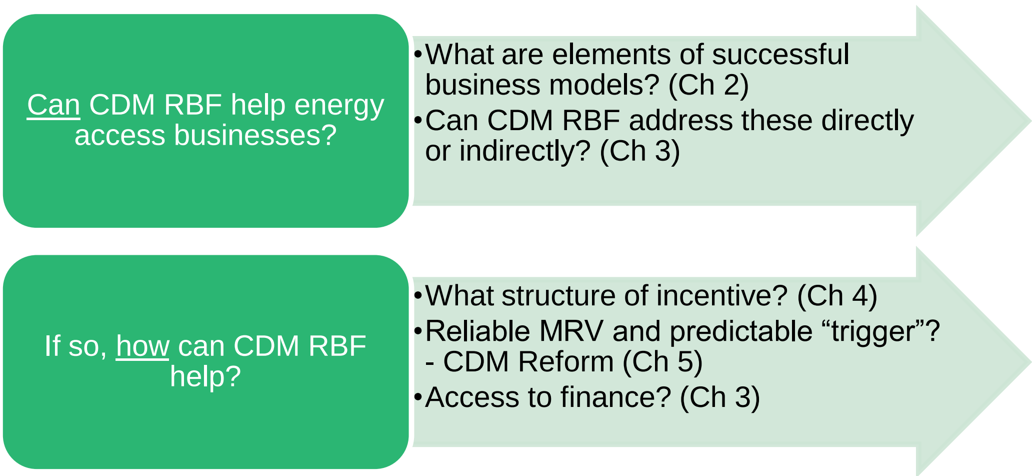
[2] This distinction is important – what defines a transaction as "results-based" is the contractual arrangement (i.e. payment after results are achieved) not the standard used to measure the results (in this case the CDM).

The objectives of this study, commissioned by the Carbon Initiative for Development (Ci-Dev), are to:

- Identify elements of viable and successful business models needed to promote energy access projects through results-based finance (RBF) to be delivered through the purchase of Certified Emission Reductions (CERs) under the CDM; and
- Identify reforms of CDM regulation required to facilitate the support of such energy-access investments by the CDM including through an RBF approach, as well as broader opportunities within climate finance to utilize RBF approaches for energy access.

Figure 1 illustrates the structure of this analysis and of the report. To answer the first question, of whether CDM RBF *can* effectively and efficiently support energy access programmes at scale, it is important to understand the elements of successful energy access business models and investigate whether CDM RBF could support each of these elements. Then, to understand *how* CDM RBF should be structured for maximum impact, requires addressing the fundamental issues of incentive structure and reliability of the measurement against which payment is made. In other words, if payments are made (wholly or in part) against CER generation, then the predictability of the CDM system has a direct impact on the credibility of the CDM RBF scheme.

Figure 1. Overview of key questions and structure of this report



The methodology for this study includes three main components, which reflect the tight time frame for the work and the wide range of literature already available on energy access and market mechanisms for climate change mitigation. The first component involved developing hypotheses about the elements of successful business models for energy access, mainly based on the key findings from the IFC energy access business model study (IFC, 2012), previous Ci-Dev work and experience with Ci-Dev pipeline building, and ESMAP’s work on results based financing (ESMAP, 2015a, 2013). The second component involved a literature review and case study analysis to test the hypotheses about successful business models. The literature review also covered the current state of CDM reform, including the CDM Executive Board’s (EB) current initiatives on simplification and streamlining the CDM. During the third component, interviews with relevant experts and stakeholders were conducted to investigate the hypotheses and the findings of the literature review and case study analysis.

Before delving into CDM RBF as it may apply to energy access, it is helpful to understand some general principles on what makes for a successful RBF agreement. Two ESMAP reports have explored this in depth (ESMAP, 2015a, 2013), as have other papers on RBF in the energy and health sectors (e.g. Barder et al., 2014; Clist and Dercon, 2014; Eichler and Levine, 2009; MFSG, 2013, Appendix 1), and these principles have been confirmed by discussions with experts in this field.

- **Shared desire for the same outcome**: RBF will only be effective if both parties have not only aligned incentives but also a shared desire to achieve the same goals – in this case, increasing access to modern energy services. While there may be broad agreement on these goals, there could be cases where there is no clear agreement on the details of how this should be achieved or what the long term goals are. For example, a funder with an interest in promoting electricity access via renewable energy and a recipient government with a strong desire to promote grid access could come into conflict if the national grid is heavily fossil-fuel based.
- **Capacity of recipient(s) to achieve the desired results**: For an RBF scheme to work, there must be local actors (private, public or non-profit) that have the technical, managerial and financial skills to distribute products, establish new connections, etc. These capacities may also vary across sub-sectors or technology areas (e.g. biomass and cooking versus grid extension). Another way to think about this is that, because RBF schemes shift more of the risk from the principal to the agent, the agent must have the capacity to manage the risks involved. In addition, if government plays a role in distributing the payments, or contributing to the results, then governmental capacity and transparency also become critical.
- **Capacity of principal/funder to provide predictable and flexible assistance**: interventions to support long term results in the energy sector will often require a long term presence in the market. The more that principals want to ensure lasting benefits for consumers, the longer they may need to maintain some form of funding or programme engagement. This can be difficult if the principal is a development aid agency with shifting priorities and subject to political changes. It can also be problematic if the funder must spend all of their allocated funds in each year, because payments in the RBF scheme will vary according to the performance of the implementing agents. If the agents do not perform and the funder must still disburse the available budget, this would undermine the credibility and effectiveness of the system. Therefore, a funder must be able to provide predictable and flexible assistance over the long haul to create confidence in the results-based scheme.
- **Recipient access to capital**: by definition, payments in an RBF scheme will come (largely) after the investments are required. This means that recipients must have access to capital to bridge the gap between investment and receiving the results-based payment – whether this capital comes from domestic sources or from complementary international programmes that are not results-based (e.g. equity investment funds).

- **Measureable results**: an RBF agreement will only work if the funder and recipient can agree on the results to be measured, which will serve as a trigger for payment, and if achieving that result is within the control of the recipient. In energy sector RBF, the measurable result could cover anything from units distributed and capacity installed, to the delivery of development benefits as a result of increasing energy service consumption. Deciding on this result is discussed in more detail in chapter 4.1.
- **Predictability of results and manageable transaction costs**: in the context of CDM RBF, where the result is CER delivery, the predictability and cost of generating CERs is a major factor in the success of CDM RBF programmes. The complexity of the CDM system, time delays for registration and issuance, and uncertainty around issuance success must be addressed for energy access programmes to be successful under a CDM RBF framework.

The report is structured as shown above in Figure 1. Chapter 2 describes the elements of successful business models, while Chapter 3 examines the potential roles for CDM RBF in supporting these main elements, including access to capital. Chapter 4 then delves into how to structure incentives under a CDM RBF scheme. Chapter 5 covers CDM reform as a way to improve the predictability and reliability of the “trigger” for payment, while Chapter 0 presents conclusions and recommendations

2. Elements of successful energy access business models

This chapter identifies the elements of successful business models for delivering energy access. The analysis focuses on those elements that are most important, rather than attempting to provide a comprehensive list of all elements and complete business models. The review draws upon not only the ESMAP and IFC reports mentioned earlier, but other literature on success factors and business models for energy access (e.g. EnDev, 2013; GVEP, 2011; SNV, 2015; Tenenbaum et al., 2014). The elements may differ according to the type and size of energy services provided, which can be divided into three main groups: household-level devices and systems, community-level systems, and grid extension.

- Energy access businesses are typically built around household-level devices (e.g. cook stoves, solar lanterns, solar home systems), community-level systems (e.g. mini-grid utilities) or grid-electrification, although some business models may include more than one technology type.
- The elements of successful energy access business models can be broadly classified into four areas:
  - **Enabling environment**: the external market framework for the sector, including regulations, policies, institutions, resource assessments (e.g. for renewable energy), standards and testing facilities, and general consumer awareness.
  - **Cost structure and cash flows:** the key revenues and costs for delivering energy services, which are impacted by product cost, targeted subsidies, access to consumer financing, supply chain financing, and access to affordable fuel sources.
  - **Efficiency and structure:** management capacity, distribution channels and network, collection systems, consumer mix, and operational efficiency.
  - **Access to capital**: corporate financing for growing businesses to create larger impact.
- While there are common elements that create success across all technology areas, there are also elements that are more important in some areas than in others

Household-level devices and systems mainly cover cook stoves, solar lanterns, and solar home systems or kits. **Community-level systems** include decentralized village power systems (SHS), or mini-grids, that provide electricity to areas unserved by the central network. Mini-grids may use a range of technologies, including simple diesel generators, hydropower, biomass or solar photovoltaic (PV). These businesses may have as few as 10 customers or serve several thousand connections, but generally use systems of 30 kW to 500 kW. The third group is **grid extension**, which usually involves a national utility and connection to a national or regional grid. The following sections examine the elements of successful business models for each broad technology area.

2.1 Household-level devices and systems

Based on the literature review and interviews with relevant stakeholders, the following elements of successful business models have been identified as important for household-level devices and systems.

- **Affordability**: the high upfront cost for modern energy devices has traditionally been one of the main barriers to increasing access. However, this is rapidly changing for many technologies. The capital costs of improved cook stoves, solar lanterns and solar PV kits have all fallen dramatically in recent decades as a result of economies of scale and technological innovation (ESMAP, 2015b; IRENA, 2015, 2013), although some technologies are still not commercial (see example in Box 1). While some products, such as biogas digesters for cooking, have utilised local manufacturing and low cost labour, many more household-scale devices have utilised low-cost mass production in China. Affordability has also been addressed through targeted subsidies, with clear boundaries for who is eligible, the time frame for the subsidy, links to operational success (i.e. actual energy consumption and not just installation) and the rationale for the subsidy level, so as not to distort existing or potential markets. Affordability is not, however, mainly an issue of total capital cost, because most poor households already spend more on traditional energy sources than they would on modern energy services – the issue is the timing of those costs, which leads to the next two points.

Box 1. Ethiopia National Biogas Programme and biogas digesters

Since 2009, the Government of Ethiopia's (GoE) National Biogas Programme (NBP) has worked to disseminate domestic biogas and develop a commercially viable market-based biogas strategy in Ethiopia. As of October 2014, the program has constructed over 9,000 family-sized biogas digesters in four regions – Oromiya, Amhara, Tigray and SNNPRS. A large number of biogas masons were trained from 2009 to 2013, with around 100 accredited masons active in the sector. The national program also provided training for over 5,600 users on maintenance, of which 2,560 are women. In spite of these initial efforts, the program has yet to reach the necessary scale that makes biogas digester implementation commercially viable. NBP, with the support of carbon finance, will continue to focus on scaling up the installation of biogas systems by making them more affordable to prospective users of the technology in rural and peri-urban areas. The NBP will also support activities along the value chain, including coordinating participation of stakeholders, promotion of biogas, training of additional masons, quality control for installations, matching skills to market needs, and support for nascent enterprises.

Historically, the financing structure of the NBP included three parts: 1) a business investment subsidy, supported by donors via the government, to the biogas construction enterprises so that the upfront biogas digester cost to households could be reduced by 30%; 2) households' own contribution equal to 70% of total biogas digester cost; and 3) public funding from international donors to support marketing, customer mobilization and provision of technical assistance. During Phase II of NBP, and in the absence of support from external donors to continue the 30% investment subsidy, GoE decided to subsidize 30% of investment cost of biogas digesters through implementation of a revolving subsidy fund. The initial contribution will be from the government and donors, with replenishment from part of the revenue generated through the sale of the resulting carbon credits. In addition, carbon revenue would be used to incentivize maintenance. This could ensure that all levels of the program are focused on promoting access to appliances, include after-sales service, and which are important in reaching the goal of a commercially viable, market-orientated biogas sector.

To generate carbon revenue from the PoA, the GoE is negotiating to sell emission reductions from 48,900 biogas digesters to be installed from 2015-2020 under Phase II of the NBP.

Source: Ci-Dev PIN for "Ethiopia Renewable Energy for Clean Cooking programme"

- **Innovative payment systems**: traditional payments (e.g. lump sum upfront payments) do not match the cash flow of poor households, who often only have small amounts of money available at any given time. Successful programmes have piloted alternatives such as fee-for-use or fee-for-access[3] systems (e.g. for solar home systems), as well as rentals instead of consumer ownership. Kenya M-KOPA, for example, allows consumers to make small daily payments for their solar kit using their mobile phone (See Box 2 and Reeder (2015)**).**

[3] A fee-for-use system would only charge the consumer when they access the service, while a fee-for-access system means the consumer pays a regular fee (e.g. monthly instalment) whether they use the service or not.

Box 2. M-KOPA Solar and innovative payment systems

An example of innovative payment systems and consumer financing is the M-KOPA Solar business in Kenya, which gives consumers the option to make small payments over time to eventually own their solar home system. The company, "founded by former executives behind M-PESA (the world's leading mobile payment platform, owned by Vodafone), M-KOPA (M= mobile, KOPA= to borrow) combines mobile payments with GSM sensor technology to enable affordable financing of solar power systems." Consumers pay as little as $30 deposit for the installation of a solar kit that would cost $200 or more. They can then use their mobile phone to make daily top-up payments to operate the system. At the end of 12 months, their payments – which are less than they would have been paying for kerosene for lighting – are enough to own the system, and they can then choose to upgrade for more power, use their payment account as a savings account, or draw upon their account to finance other appliance purchases.

In less than 3 years, M-KOPA connected 150,000 homes in Kenya, and is growing at 2,000 homes per week. The business has also launched in Tanzania and Uganda, with more than 20,000 consumers in these markets. They have estimated the GHG impacts of these interventions, based on CDM methodologies, and have also conducted surveys to quantify other benefits, such as children's increased time studying, families spending more time together, and an increased perception of safety.

As part of their next phase of development, M-KOPA intends to utilise carbon financing to catalyse both market expansion (e.g. Tanzania expansion and new product launches) and internal cost and business efficiencies (e.g. research on a lower cost pay-as-you-go system, implementing a product recycling and re-use system). Some of these costs could provide examples of the "barrier costs" and "component costs" discussed in chapter 4.2. M-KOPA submitted a "prior consideration of CDM" form to the UNFCCC on September 2014.

Source: M-KOPA (Reeder 2015)

- **Consumer financing:** product costs for solar home systems in particular can be high, so companies may need to offer financing to their customers. Options include providing a combination of credit to cover a deposit and additional monthly payments to cover the balance. Such schemes may also benefit from government subsidies per connection. Another approach is to partner with microfinance institutions and rural banks that already provide financing in target markets. Local development banks can be a strong partner for providing consumers access to credit via other implementing organisations. The refinancing system for solar home systems in Bangladesh, supported by the World Bank and other donors, is one of the most successful examples of this (Asaduzzaman et al., 2013) (see Box 3). Other schemes, specifically cook stove projects, allow flexible repayment terms that correspond to the cash saved, in this case on charcoal.
- **Strong distribution channels**: many of the target consumer groups for devices are in remote areas, and the high cost of setting up a distribution channel can make the final cost of the device prohibitively expensive. Successful programmes have often developed partnerships with organisations that already have rural networks, including non-governmental organisations (NGOs), and agricultural supply companies. SunnyMoney, for example, partners with networks of schools to market solar devices in East and

Southern Africa, while International Lifeline Fund works with supermarkets, not-for-profits, women's groups and entrepreneurs to distribute improved cook stoves (SNV, 2015). Mobile telephony companies also have strong dealer networks, which are sometimes leveraged successfully.

Box 3. Bangladesh solar home system programme

One of the most successful solar programmes in the world, and an example of innovative results-based financing, is the Bangladesh solar home system programme. Since 2003, the programme has distributed close to 2 million systems throughout Bangladesh.

The financial support for the SHS goes through several intermediaries. Local partner organisations (POs), which are all non-profits with rural networks, install a solar home system. The consumer pays 10-15% down payment and receives a micro-credit loan for the balance, to be repaid over two to three years at 12% interest. On the basis of this "result" (i.e. the purchase of a SHS), the POs receive a refinancing from the state-owned financial intermediary IDCOL for 80% of the loan value, repayable in 6-8 years at 6% interest. This makes cash flow available to the PO to invest in the next system. IDCOL, in turn, receives financing for a package of micro-credit loans from the Government of Bangladesh (GOB) (3% interest for 20 years), who in turn receives concessionary loans from the World Bank (0.75% interest for 40 years with a 10 year grace period). The World Bank provided an initial tranche of funding to the GOB to start the programme. Each time this special account is exhausted, the GOB requests replenishment based on quarterly reports of SHS installations and flows of funds to IDCOL and POs.

In addition to the micro-credit loans, there is a $20 capital subsidy for very small systems (i.e. up to 30W peak). This is also results-based, so is released to POs once the system is sold to the consumer. The funding for this comes from grants provided by donors. This subsidy was much higher in 2003 ($90/system) but rapid declines in panel costs, innovation in design, economies of scale, and the advent of LED lighting have brought down costs, so the subsidy has been reduced. Finally, there is a $3 per system institutional development grant, also results-based, that helps POs with training, setting up collection systems, and overseeing programmes.

Because IDCOL earns a spread on the cost of financing (i.e. they pay lower rates for the funding than they charge to POs), as do the POs, this can be a sustainable business model. At the same time, IDCOL addresses national standards and technical issues, implements inspections and monitoring, and oversees the quality of the programme.

The long and complex CDM project cycle meant that it took five years for this programme to be registered as a CDM PoA. This meant that the business model was largely developed before carbon finance was available. Nevertheless, the IDCOL programme was registered in June 2012, and has 13 CPAs already, with expected CERs of 568,000 per year, making it one of the largest PoAs registered to date. Carbon revenue can now replace other donor support for the programme, as well as ensure the sustainability of the programme by paying for maintenance costs.

Source: Asaduzzaman et al. (2013) and interview with Zubair Sadeque, World Bank.

- **Supply chain financing:** a lack of working capital at one or more stages of the supply chain can be a barrier to market access. This can be easier to resolve for large corporations, which can leverage their balance sheets and brand name to quickly develop strong supply chains, based on, for example, using existing warehousing facilities and providing distributor credit facilities. An example of this for solar lighting is the oil multi-national Total's lead in the Awanago programme, which has distributed 1 million devices up to 2015 (Kisseka, 2015). As another example, in the Bangladesh solar home system programme, supplier credit from major equipment dealers gives installers time to receive the results-based incentive before paying for the equipment in full (see Box 3). Smaller players have also been exploring innovative ways to deal with working capital by selling to large, non-conventional dealers (i.e. dealers not traditionally involved in the distribution and retailing of household devices), which may include local conglomerates or multinational corporations. These dealers serve as aggregators and are well placed to provide the necessary trade finance to retailers downstream. An example of this approach includes Fenix International, who have developed an exclusive distribution and licensing agreement in Uganda for an MTN-cobranded solar kit, with the latter being responsible for imports (e.g. logistics, customs), warehousing, distribution and assisting with servicing devices (e.g. dealing with warranties and any product returns or replacements) (Proctor, 2013).

- **Product quality and consumer confidence:** building knowledge, awareness and confidence that a product meets certain quality standards is essential to convince cautious customers who may be reluctant to risk their money on unfamiliar technology and products. Manufacturers have used a variety of tactics to overcome this barrier, such as word-of-mouth marketing, publicly funded radio campaigns, and roadshows. The Lighting Africa public awareness raising programmes, and efforts by local stove makers such as Tizazu in Ethiopia to demonstrate new products directly to consumers, are good examples of this (see Chapter 3 of IFC, 2012). Awareness raising and market development can, however, be an important financial cost, and may add 6 to 10 percent to device costs. In addition, successful programmes have initiated or complied with rigorous quality standards and testing protocols.
- **Business development skills:** strong management capacity, strong capabilities along the value chain and support for entrepreneurs are all essential to ensure the growth of a business in the device sector. A lack of trained personnel has often been a barrier to the scaling up of cook stove and solar home system businesses.
- **Supportive tax and duty regime:** inconsistent government duties discriminate against one technology over another, and can distort markets while limiting the potential for disruptive technologies to enter and reach scale. Governments sometimes impose heavy import duties on solar lanterns and SHS, improved cook stoves, or their key components, which increases prices and limits market penetration. A Lighting Africa survey of a dozen new market areas for solar lighting in West Africa[4], for example, showed that import duties range from 5 to 30 percent. Combined with additional taxes such as value-added tax, the total tax burden can be up to half of the end-user cost. Where tax exemptions are

[4] Available at www.lightingafrica.org.

available, it is also important that they be consistent across technologies and that import processes are streamlined.

2.2 Community-level systems

Based on the literature review and interviews with relevant stakeholders, the following elements of successful business models have been identified as important for community-level systems:

- **Scope/coverage:** in order to size systems optimally, mini-grids require a good mix of consumers who will provide sufficient and reliable base load demand. This can best be achieved by serving a mix of households, small and medium enterprises (SMEs) and larger customers (including larger utilities), with the larger consumers providing a more predictable demand for electricity over time, and the ability to pay for it.
- **Reliable and affordable fuel/energy source:** where available, biomass-fuelled thermal plants can have distinctive cost advantages, particularly when the biomass is a waste product from other industrial activity (e.g. sugar processing, pulp and paper mills). Where hydropower is an option, the lack of fuel-related operating costs makes it attractive, although project developers need access rights for the use of the water, where this is regulated. Solar is always an available resource, and can be affordable if the higher upfront costs can be managed through financing mechanisms, and if paired with lower capital cost diesel in hybrid systems.
- **Good billing and collection systems:** ensuring that customers, often in extremely poor areas, pay for the electricity delivered through a mini-grid is essential to ensure the supplier’s survival. Given the importance of this issue, innovative solutions have been found to ensure good billing and revenue collection. Some companies are installing low-cost meters and simple circuit breakers that allow for easy disconnection in the case of non-payment. Others charge fixed monthly fees for a limited service, such as sufficient power for two lights and charging of appliances, generally collected a month in advance. Upfront collection of payments by incentivized door-to-door collectors has also been implemented, as have pay-as-you-go schemes involving scratch cards and text messages to the network operator.
- **Business and management skills:** formal business skills may not be an initial requirement for mini-utility success, but they do become critical for scaling up beyond a single site or a handful of sites. This is particularly true for mini-utilities using renewable technologies, which are more sophisticated and have more complex maintenance requirements than diesel generators.
- **Favourable regulation-tariffs, licensing, smart subsidies:** mini-utilities must be allowed to operate under a regime where tariffs allow an attractive return on investment. There are circumstances where some degree of subsidy is needed to make mini-grids profitable. Subsidies can help offset the cost of connections, significantly improving financial performance and allowing them to reach households in poorer areas. An example of this in the carbon financing area is the connection subsidies provided under

the Senegal rural electrification concessions programme (see Box 6). Another option is borrowed from businesses in other sectors such as mobile telecommunications, who have realized that removing high upfront costs will increase growth and profitability. For mini-grids, waiving the connection fee from the consumer can increase the amount of capital required by the supplier by as much as 30 percent, and this is an area where targeted subsidies are being effectively channelled. A further option is to subsidize power plants with high capital costs. At the same time, regulations for licensing and access to a consumer base (e.g. concessions for providing energy services) should not prejudice mini-grid operators versus the national grid operator. This includes making provisions for what happens if the national grid is extended to the area served by the mini-grid.

- **Access to finance to scale up, including concessional finance:** Mini-grid operators need sizable investment to scale up, yet most struggle to raise sufficient debt and equity capital for this. The ongoing success of community-level systems is linked to their ability to access these funds. Most large utilities are financed by at least 50 percent debt, and similar levels would be reasonable for more mature mini-grids, although, so far, few have managed to access commercial finance.

2.3 Grid-based electrification

Based on the literature review and interviews with relevant stakeholders, the following elements of successful business models have been identified as important for grid-based electrification.

- **Good billing and collection systems:** some of the solutions to revenue collection that are highlighted above for community-level systems also apply to grid-based electrification, with specific emphasis on the use of prepayment meters. Like prepayment for mobile phones, the customer buys tokens with a unique code, which is entered into the meter to credit the account and supply power. When credits run out, the account is not disconnected, but the electricity ceases, to be started again when the customer again has cash available.
- **Efficient business operation, including reducing technical and non-technical losses**: High non-technical losses (i.e. theft of electricity) is often a larger problem for grid-based systems than community-based systems. In this respect further solutions may include installing remotely readable meters, installing connections and metering in groups to prevent tampering through social pressure, raising awareness about the need to connect to the power system legally, and providing incentives such as basic life insurance and internet access to customers who pay on time.
- **Consumer finance**: for grid-based electricity, one of the most prohibitive costs to consumers is the relatively large upfront connection fee. A number of utilities around the world therefore provide consumer finance by dropping upfront connection charges in order to increase their customer base. This option is workable if the utility can recover the cost of connection through the sales of power, but may also require the company to attract further private equity and debt finance. The Uganda rural electrification

programme, for example, is using carbon finance to introduce longer instalment payment options for new grid connections (see Box 4).

- **Policy environment to encourage private participation:** removing expansion limits and removing restrictions on supplying informal settlements for utilities can be important factor in extending the grid.
- **Cost-reflective tariffs, sometimes in combination with smart subsidies:** as for community-level systems, allowing flexibility in tariff regulation would be a welcome step towards ensuring the commercial viability of grid extension projects. Utility investors must be able to recover their costs through tariffs. This may be through transparent cross-subsidies among consumer groups, or by regulators setting different tariffs for different areas, based on the cost of delivery. Smart subsidies for grid extension could take the form of charges on customers in urban areas, to create a fund to transparently cross-subsidize service in rural areas that are more expensive to serve.

Box 4. Uganda's rural electrification programme and carbon finance

The first phase of Uganda's Rural Electrification Strategy and Plan (RESP I, 2001-2012) fell short of the national goal to connect 220,000 rural consumers to the grid, reaching only 161,000. The lessons learned from RESP-I will be employed to accelerate rural electrification rates in a new Rural Electrification Strategy and Plan (RESP II, 2013-2022). A review of the first phase identified high initial connection costs as one of the major barriers. To meet the new goal of 1.3 million grid connections, grid extension costs will now be addressed by revising the technical standards to reduce the connection cost by 20%, while still providing adequate service. The government will also establish a revolving fund that serves as a working capital loan to enable electricity service providers to offer instalment payments to consumers for their connection costs. Carbon finance will be blended with the revolving fund to create a larger fund to accelerate household connections.

For off-grid electricity, after only installing 22,000 solar home systems between 2001 and 2012, the ambitious new goal is 140,000 new solar home system connections by 2022. Carbon finance will also support enforcement of technical standards and extended warranties on systems, because product quality and after-sales service are still barriers to uptake, as well as supporting consumer awareness raising campaigns by the Rural Energy Agency.

Source: Ci-Dev PIN for "Accelerating Electrification through Grid Extension and off-grid electrification in Rural Areas of Uganda"

- **Professional management team to secure financing:** business and management skills may need to be improved for smaller utilities, particularly when required to secure debt financing. Larger utilities and multinationals would be expected to have a professional management team and to effectively leverage this asset when growing their supply base.
- **Access to finance, including concessional finance:** As for both device-based and community-based projects, access to corporate finance is essential for scaling up the activities of the operators. For grid-based electrification, however, the high capital investment required to generate power and, in particular, extend lines means that purely commercial models for grid electrification are still relatively rare. Public-Private Partnerships (PPPs) involving public financing that subsidizes private investment have a

good track record in extending the grid. A number of models for PPPs and public finance exist, including providing output-based subsidies for new connections. Public financing through the provision of smart subsidies aimed at covering the upfront costs of connections appears to be the most successful.

Note that the assessment of grid-electrification business models assumes that there is sufficient generation and transmission capacity to supply consumers. Given the wide gap between supply and demand in many poorer countries (Eberhard and Shkaratan, 2012), this is not always that case. So while this report focuses on CDM RBF schemes that extend access to new consumers, for grid-electrification there may be a need for separate climate finance initiatives that support centralised power generation and transmission.

2.4 Summary

While there are common themes that create success across all technology areas, there are also elements that are more important in one area than in others. For example, household-level programmes face barriers in terms of consumer awareness than community-based or grid extension projects do, because consumers are more familiar with grid electricity. Similarly, supply chain financing is more important in household-level programmes, while business and management skills are important for scaling up community-level systems and managing both mini-grid and large grid utilities. Table 1 provides a summary of these elements of successful business models and their relative importance in the main energy access technology areas. Broadly speaking, these elements can be grouped into four areas, which are relevant for the analysis of whether CDM RBF can support these business models:

- **Enabling environment**: the external market framework for the sector, including regulations, policies, institutions, resource assessments (e.g. for renewable energy), standards and testing facilities, and general consumer awareness.
- **Cost structure and cash flow:** the key revenues and costs for delivering the energy services, which are impacted by product cost, targeted subsidies, access to consumer financing, supply chain financing, and access to affordable fuel sources.
- **Efficiency and structure:** management capacity, distribution channels and network, collection systems, consumer mix, operational efficiency.
- **Access to capital**: different from consumer finance, this is about growing larger businesses to create larger impact.

The next chapter now turns to an analysis of how CDM RBF schemes can or cannot directly support these four critical areas.

Table 1. Elements of successful business models and their importance in the main energy access technology areas

	Key Success Factors	Devices	Mini-Grids	Grids
Enabling environment	Favourable regulation: cost-reflective tariffs		✓✓	✓✓
	Supportive tax and duty regime: reduced import tariffs	✓✓		
	Quality standards and testing protocols	✓✓		
	Consumer confidence: building knowledge and awareness	✓✓		
Cost structure, cash flow	Affordability: low cost manufacturing (e.g. solar kits), outsourcing, local materials and labour (e.g. improved stoves), targeted subsidies	✓✓	✓✓	✓✓
	Supply chain financing: to provide working capital to retailers	✓✓		
	Reliable and affordable fuel/energy: to ensure affordable electricity to the consumer	✓✓	✓✓	
	Consumer finance: to provide for the upfront costs of device purchase or connection	✓✓	✓	✓✓
Efficiency and structure	Innovative payment systems: pay-as-you-go, low cost meters, rentals, pre-payment meters, flexibility	✓✓	✓✓	✓✓
	Good billing and collection systems: to ensure poorer customers can pay for the electricity delivered		✓✓	✓✓
	Broad consumer mix: including productive uses/SMEs, possibly "anchor client" (i.e. large consumer or utility)		✓✓	✓
	Professional management team: business and management skills for large scale success and replication to secure financing	✓✓	✓✓	✓✓
	Strong distribution channels: options include NGOs, sales force in rural areas, dealer incentives or partnerships with large companies in other sectors such as mobile telephony	✓✓		
	Efficient business operation, including reducing technical and non-technical losses		✓	✓✓
Capital	Access to corporate and project finance to scale up, including concessional finance	✓	✓✓	✓✓
	Innovative financing mechanisms: pre-financing, structured financing	✓✓	✓✓	✓✓

3. Where CDM RBF can support energy access business models

Based on the understanding of what creates successful energy access business models, the next question is whether CDM RBF could support these key areas. Each section below considers how CDM RBF might work in this area, particularly given the need for most of the payment to be disbursed after project implementation and the need for clear triggers for payment.

- The strongest direct impacts from CDM RBF will be on the “cost structure and cash flow” elements through the payment of direct incentives, and the standards and consumer acceptance aspects of the “enabling environment”. The success of this strategy relies on strong intermediaries, local financing institutions, or supply chain financing that can bridge the gap between the time of investment and receipt of the incentive. Using a mix of payment milestones can also reduce this gap, as well as using incentives to directly support maintenance, after-sales service, and warranty enforcement. Applying performance incentives across the entire sector can minimise market distortions.
- Using eligibility criteria for countries or participants can impact the “efficiency and structure” elements, and indirectly on the “enabling environment”, but this passive strategy may take time to yield results.
- Disseminating best practices in business models, and the use of some of these practices as eligibility criteria, could incentivise business model innovations without the higher transaction costs and process time of in-depth due diligence.
- Complementary instruments are needed to fully address the policy aspects of the “enabling environment” for energy access programmes.
- While there are some examples of linking project finance to delivery of CERs, carbon finance has not traditionally provided significant upfront capital. Modest forward payments of CERs and a financing institution providing concessional loans against the future stream of CERs have helped some projects, but these are the exceptions and not the rule.
- An alternative would be to package equity investment funds and other structured financing tools with a CDM RBF programme, so that recipients of performance-based payment contracts might qualify to receive other forms of capital financing. The role of donors in reducing risk in these funds, and “crowding in” private capital is essential.
- One avenue for bundling these complementary instruments, including the project and corporate financing instruments, is to do so under the umbrella of national or sectoral mitigation programmes, such as Nationally Appropriate Mitigation Actions (NAMAs) in the UNFCCC or similar new instruments that could become part of the Paris climate change agreement this year. These could encompass the CDM RBF instruments in the energy access sector as well as the instruments for capacity building, regulatory support, and provision of project and corporate financing to energy access businesses.
- The operationalisation of the larger scale climate financing channels, such as the Green Climate Fund (GCF), could represent a substantial new source of support for comprehensive sectoral energy access programmes and for a range of RBF initiatives for energy access.

3.1 Enabling environment

CDM RBF can impact some aspects of the enabling environment more than others. For quality standards and testing protocols, for example, a requirement within the CDM RBF programme that projects meet certain standards to receive an incentive can increase the market acceptance and use of the standards. Whether this transforms the entire market depends on the market share and coverage of the RBF scheme, and also whether the RBF scheme influences government action on national standards. The same would be true of warranty enforcement incentivised by a CDM RBF scheme, which is being explored by Ci-Dev in an Ethiopian off-grid renewable electrification programme. Similarly, a successful CDM RBF intervention for improved cook stoves could also include raising consumer awareness and confidence in modern cooking technologies, although again the transformative impact depends on the scale of implementation.

Many of the critical interventions in policy and regulation necessary to promote increased access, however, must be put in place *before* the energy access market can develop rapidly. In addition, while these interventions provide an enabling environment for the entire market, they are not necessarily quantitatively linked to specific results (e.g. number of new connections or energy service consumption levels). This makes it difficult to use 100% results-based payments to address these needs. Under the CDM, for example, while a conducive investment and policy environment was often cited as a reason for success in a particular country (Burian et al., 2011; Ellis and Kamel, 2007; Okubo and Michaelowa, 2010), the development of CDM projects was rarely credited with influencing policy and overall market conditions[5]. In addition, the current CDM rules do not allow for crediting policies or standards, including those directed at increasing access, but expanding the CDM to a broader scope could potentially address this (see chapter 5). Even within the current CDM framework, however, there are several options for how a CDM RBF funder might support the policy aspects of the enabling environment:

- Establishing **country eligibility criteria** for the CDM RBF scheme that would require certain market conditions to be in place (e.g. national quality standards, non-discriminatory grid access codes) before private-sector actors in that country could receive the incentives. The main drawback of this strategy is that it is passive, so it would not directly catalyse market development in countries where the enabling environment is currently weak.
- A **parallel funding instrument** as part of a national programme of capacity building could be used by a CDM RBF funder. This can be a cost-effective way to use scarce public funds for supporting market development in some cases. The Global Lighting Initiative, for example, focused on standards and testing protocols rather than direct financial incentives for lighting, and was able to catalyse the distribution of millions of efficient solar lanterns (Lighting Global, 2015). Another option would be a “national readiness fund” to support policy and regulatory development, similar to how Ci-Dev’s

[5] There are some examples, however, of a CDM PoA influencing policy changes, such as the case of compact fluorescent lamps in India, where the growth of CDM PoAs led to the government mandating a minimum power factor for all CFLs sold.

current “readiness fund” targets project developers. Such a programme would, in principle, fit well within the current description of Nationally Appropriate Mitigation Actions (NAMA) for developing countries under the UNFCCC or a similar broad mitigation instrument that could come from the current negotiations on a new climate change agreement (see chapter 3.4), because the policies would facilitate the success of the RBF mitigation scheme. Although NAMAs have not currently received significant flows of funding, they are the only sectoral or national mitigation instrument that is currently operational under the UNFCCC. This could change as a result of the Paris climate change negotiations this year, and also if the GCF takes a decision to support NAMA-type programmes at a national level. A package of such funding could even be partly results-based, so promulgation of new regulations or establishment of a testing centre with quality standards would be required before the final part of the financing was released.

- On a similar theme, the CDM RBF funder could **partner with host governments to design the programme**, to ensure that both parties had an interest in the success of the programme. This is true of several of the rural electrification initiatives (grid, mini-grid and off-grid) under the Ci-Dev pipeline (e.g. Senegal, Mali, Uganda), where, although the implementing agents will be private companies, the programme was designed in partnership with a national agency responsible for rural electrification. The funds may also flow through these agencies, although they could also go directly to the implementing agents.

3.2 Cost structure and cash flows

This is the area where energy sector RBF has been used most often – to provide direct incentives to implementing agents following the verification of their results – and also how the investment in many CDM initiatives are justified. The impact of CER revenues on ongoing cash flow is traditionally how CDM could catalyse new action, and the basis for economic and financial valuation of CDM projects and programmes. This impact of CER revenues varies considerably by project type, of course, because of both the relative costs of the various energy technologies and also the emission reductions per unit or per household. Table 2 shows the typical emission reductions from different energy access technologies on a unit basis.

Table 2. Typical emission reductions per unit for different energy access technologies

Energy Service	CERs per Energy Technology Unit
Improved Cook Stoves	2 CERs per year over 2-5 years
Biogas	3-5 CERs per year over 10 years
Solar PV Home Systems	0.2 – 0.5 CERs per year over 5-10 years
Electrification Mini-grids	0.3 - 0.7 CERs per year (per household) over 10 years
Micro-Hydro	0.4 -0.5 CERs per year (per household) over 10 years

Source: Practical Action

This important role of the RBF incentive means that the predictability of the CDM system in delivering the verified result, as well as the transaction costs of meeting the upfront and ongoing CDM requirements, are of critical importance. These are addressed further in chapter 5. There are multiple ways in which carbon revenue may change the cash flows: not only by direct payments for CERs (e.g. covering specific costs such as grid connection costs or micro-financing interest payments), but also by reducing project risks (e.g. hedging against exchange rate fluctuations) so that the project is less expensive to finance.

The literature on RBF highlights several considerations for making performance incentives effective for CDM RBF:

- The presence of **strong intermediaries or local financial institutions**, with financial and technical capacity, is critical for the CDM RBF scheme to work effectively, particularly for programmes focused on devices. The individual implementers in the CDM RBF scheme may not have the financial capacity to wait until implementation is complete before receiving the incentive payments. An intermediary would provide a bridge between the investments and the RBF payments. An example is IDCOL in Bangladesh, which provides financing to the implementers of the solar home system programme, and then receives additional concessional financing from the World Bank (see Box 3). Even if the institution is not directly involved in the CDM RBF scheme, if they can provide bridging finance to implementing agents, they will facilitate the programme. The Orb partnership with K-Rep bank in Kenya to finance solar lighting is another example of this (see Box 5). All of this means that the developers of a CDM RBF scheme should **assess the local capacity of potential intermediaries and possibly partner with them** in designing and implementing the programme. For grid extension and mini-grid programmes, the intermediaries may actually be national or regional utilities, concessionaires, or licensed independent power producers, whose financial and institutional health can also impact the success of the programme. For grid extension in particular, the availability of adequate generation and transmission capacity is also critical.

Box 5. Orb Energy Kenya Solar Lighting

Orb Energy launched in 2006 in India selling a proprietary, high quality solar lighting system, and built a nation-wide network there of 160 branches to support consumers. Orb intends to replicate this business model in Kenya, also using carbon finance. Orb will pioneer the use of micro-finance for solar lighting products in Kenya, initially partnering with K-Rep bank to offer 12-month financing for products sold through K-Rep branches. Orb will also explore similar partnerships with Savings and Credit Co-operatives to reach more consumers. At the same time, Orb will replicate the branch network model, and begin to establish both in-house and franchised branches throughout Kenya. Orb and ClimateCare will use carbon finance partially to finance the expansion of the distribution network, to support after-sales service through a branch network, and to contribute to consumer financing through partnerships and a guarantee facility.

Source: Ci-Dev PIN for Solar Lighting in Kenya

- Additional **supply chain financing**, which may come through non-RBF loans and grants, can also bridge the gap between the investment needs and timing of RBF payments. As discussed earlier, in Bangladesh the equipment suppliers provide two to three months' credit to implementing agents, which gives them time to install a system and receive the incentive before they must pay for the equipment. The funders of an RBF scheme could therefore **partner with equipment suppliers in-country to ensure that supplier credit is available**, or even arrange that a revolving fund be set up to support suppliers in extending this credit**.**
- The CDM RBF incentive can **minimise market distortion** by allowing **access to all actors across the entire sector**, rather than only supporting specific organisations, and being **"technology neutral"**. For example, rather than a CDM RBF scheme providing an incentive to one or two cook stove companies, a performance incentive should apply to any actor that can deliver a useable product of acceptable quality and meet a minimum standard for business operations (e.g. warranties, after-sales service). Standardized baselines could be used here to provide clear and straightforward incentives for these technologies. A more difficult question is whether incentive should be "technology neutral". For example, if the objective of the programme is access to electricity services, and the incentive is linked to the attributes (and possibly consumption) of those services, then it should not make a difference how those services are provided (e.g. off-grid, mini-grid, grid, or renewables versus fossil fuels). If a particular funder wants to support renewable energy solutions, however, they could provide additional incentives for a different trigger (e.g. one payment for usable electricity consumption and another payment for the continued operation of a renewable energy system). An example of this would be the Senegal rural electrification programme, which provides incentives based on the service level of new electricity connections, not based on the technology used to make that connection. The programme then has a supplemental and separate incentive scheme for off-grid renewable installations (see Box 6).
- While the structuring of payments is discussed in more detail in chapter 4.5, a CDM RBF scheme almost certainly needs a **mix of payment milestones**, so that some funding is available earlier in the project cycle but the majority provides an incentive for performance. This is common in other RBF programmes as well (see Box 6 for an example), although less common in traditional CER purchase contracts. A notable example is that some early World Bank ERPAs did include up to 25% upfront payment for CERs (Ci-Dev, 2015). For device programmes, the milestones could relate to the stage of overall implementation or the percentage of total units distributed or commissioned, while for grid extension or mini-grid programmes the milestones could be linked to investment in key distribution infrastructure as well.
- These incentives could be used not only to bring down capital costs (depending on their magnitude) but also to **address ongoing maintenance costs**, compliance with technical standards (e.g. grid codes, product standards), and replacement of parts (e.g. batteries for SHS). This will vary by technology – the CDM RBF incentive may be sufficient to impact the capital cost of cook stoves significantly, for example, but for solar PV it may only be sufficient for addressing maintenance costs.

Box 6. Senegal rural electrification programme

The Senegal Rural Electrification Agency (ASER) has the responsibility to define strategy for rural electrification. To achieve national electrification goals ASER has, between 2000 and 2010, electrified more than 1,000 villages throughout the country, using grid extension, solar home systems, and isolated mini-grids connected to diesel generators. To accelerate access, the Senegalese Government decided in 2009 to initiate a two-track programme to dramatically scale up rural electrification. One component is to finance the extension of rural medium voltage (MV) lines in areas where diesel mini-grids have been installed, to displace diesel generators and connect the villages to the existing interconnected transmission and distribution network, as well as to increase the number of households and enterprises that have access to electricity. This component would connect up to 100,000 households to the grid over the next 5 years. In parallel, a second off-grid electrification component was launched to use solar home systems and hybrid diesel-solar PV mini-grids to reach up to an additional 95,000 households or more, and to distribute 300,000 solar-charged LED lanterns.

All components will be implemented through an innovative concession programme that harnesses private sector finance, including international capital and expertise, to extend access to affordable energy services. In the concession financing model, the country is divided into 10 concession areas, and an international bidding process has been used to select private sector concessionaires. Each concession area had a required minimum number of connections and a maximum total subsidy for connections. Bidders competed to provide the most connections with the fixed subsidy, and had autonomy to determine the technologies used to reach those households. The connection subsidies are partially results-based, being paid in tranches over the first few years of the programme, based on installation records.

The ASER programme is developing a PoA for the entire rural electrification programme. The carbon revenue would be used to support an additional renewable energy-specific subsidy and to ensure that the financial returns of the concessionaires will be sufficient to make the programme sustainable.

Source: Ci-Dev PIN for "ASER Senegal Rural Electrification Program" and interview with Ousmane Fall Sarr, ASER

3.3 Efficiency and structure

Part of the value of an RBF scheme comes from the agent's autonomy in how they deliver results. As with the policy aspects of the enabling environment element discussed earlier, a pure CDM RBF scheme (i.e. all payments made after delivery of results) would not directly assess or support a specific business model, except that a more successful business model would be more likely to receive the incentive. However, there are overall scheme design options that can support innovation. These include the following:

- As a starting point, the CDM RBF scheme could conduct a **due diligence** on potential implementing agents to assess the innovativeness of their business models, the way Ci-Dev currently investigates and provides support to potential recipients. While this is an ideal strategy for a pilot programme, scaling up such an approach, even by using intermediaries, would drive up the overheads and transaction costs of the overall funding initiative. Climate finance mechanisms need to channel tens, or even, hundreds of billions of dollars. Under the CDM, for example, a flow of $30 billion in results-based payments went to thousands of organisations in more than 110 countries (Fenhann, 2015a).

- An alternative to this level of individual organisational analysis would be to use knowledge tools associated with the CDM RBF scheme to **disseminate best practices** in energy access business models and/or set certain business practices as **eligibility criteria** for accessing the finance. In terms of the first point, educational and capacity building programmes such as Carbon Finance Assist (CF-Assist)[6] have played this role. This is also part of the role of the Ci-Dev Readiness Fund, although focusing mainly on institutions with whom the fund has signed a Letter of Intent. On the second point, it is common for both public and private tenders to specify objective company or institutional eligibility criteria (e.g. capitalisation, ownership structure, turnover relative to project size). The lessons from the early Ci-Dev pipeline could therefore be translated into business model characteristics that could become requirements for future programmes.
- To address some of the distribution channel issues, the RBF scheme could explore **developing upfront partnerships** with organisations that already had extensive and **effective networks** (e.g. mobile telephony companies), to negotiate with them to provide access to their networks or customer base. An example of this connection negotiated by a project developer is the partnership between Nova Lumos and mobile telephone giant MTN Nigeria.[7] This might also take the form of a **non-RBF grant funding** stream for incubating innovative partners (see discussion of raising capital below).
- As discussed earlier, if the desired objective is a certain level of energy access (e.g. certain tier level or level of consumption of energy services), then **technology neutrality** provides the most flexibility for implementing agents and allows for innovation. In practice, however, technology neutrality can be difficult to implement, and could conflict with the GHG mitigation priorities of a CDM RBF instrument (e.g. if electricity is provided by fossil-based grid or mini-grid electricity versus by renewable energy sources).

3.4 Access to business capital

Access to business capital is one of the most important issues in energy access, particularly to dramatically scale-up access. Serving another billion people is only possible if businesses can invest, make profit, and have capital to expand when they succeed. As with certain enabling environment elements, implementing agents need access to capital *before* they can create businesses at scale, which poses a structural challenge for purely RBF instruments.

A challenge with traditional results-based CDM funding has been the lack of knowledge and trust in the international and local financial community of the commodity which was to be delivered under the Emissions Reduction Purchase Agreement (ERPA)[8] (i.e. CERs). This

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[6] http://wbi.worldbank.org/wbi/stories/carbon-finance-assist-program-guides-developing-nations-through-complex-mechanisms

[7] www.nova-lumos.com/mtn-nigeria-and-nova-lumos-partner-to-bring-affordable alternative-mobile -electricity-to-nigeria-for-the-first-time/

[8] An ERPA defines the terms of generation, ownership and transfer of CERs (or other emissions reduction units) from climate change mitigation projects and also establishes the allocation of risks among the parties involved.

could be expected for any RBF scheme where payment is to be made based on emission reductions or other "intangible" products, and where the buyers are subject to political decisions on funding. In addition, the widespread cancelation of ERPAs after the carbon price crash has increased distrust of this instrument, especially among the few local financial institutions who have dedicated a desk for carbon financing of CDM projects. This distrust may well impact the reputation of the commodities used as the basis for revenue generation in future RBF schemes. In addition, the uncertainty, transaction costs and time delays in the CDM system need to be addressed to increase investor confidence that the project developers can deliver the desired result.

The simplest way for an RBF scheme to support access to capital for project developers is through **front-loading of revenues** – making advance payments for a portion of the project's carbon revenue, based on a risk assessment and due diligence process. Historically, some CER purchasers were willing to agree to advance payments of up to 25% of the value of the ERPA, but this was the exception rather than the rule (Ci-Dev, 2015).

Throughout the development of the CDM, project owners – and the broader CDM community - hoped that the legally binding contractual nature of the ERPA would ensure that it would play a crucial role in securing funding from local or international banks(Baker & McKenzie, 2004; IETA, 2013). The potential for an ERPA to increase the investment attractiveness of the project was emphasised from an early stage of the CDM right through to the close of the first commitment period of the Kyoto Protocol (Hedbrandh, 2011; Merzbach Group LLC, 2003; Pashchenko, 2009). The history of the CDM and carbon finance does include some examples of **linking project finance to future delivery of CERs**. An early example was the deal structured by the World Bank and Rabobank for the Plantar CDM project in 2001. Rabobank agreed to provide a loan to Plantar based on the expected value of an ERPA signed with the World Bank (as a trustee of the Prototype Carbon Fund), which would provide hard currency payments for the CERs. The IFC has also lent against ERPAs for CERs contracted either by itself or creditworthy third-parties, generally as mezzanine or equity financing (Ci-Dev, 2015). Another example was the landmark post-2012 transaction agreed in 2010 by NEFCO and KfW Development Bank, which used an offtake agreement (TemaNord, 2011). The agreement included loan disbursement using the ERPA as collateral, which monetized payment for grid connection costs for two large Mexican wind power projects. However, as a report on Nordic experiences in the carbon market notes, "these deals are all too uncommon in the carbon market, where conventional security instruments are usually demanded, if advanced payments are offered at all" (op. cit.). Some additional experiences with project finance and ERPAs are presented in Box 9, but the main message from the literature and stakeholders is that CDM RBF instruments will not, on their own, secure project financing for rapid business growth. The Ci-Dev pipeline of projects is seeking to challenge this, by working with established project developers as partners to leverage an ERPA to attract investment and debt financing, for example in Rwanda with Inyenyeri (see Box 7).

Box 7. Rwanda Inyenyeri biomass pellet stove business model

Unlike many companies in the improved cook stove field, Inyenyeri focused on the sales of a renewable and clean burning fuel source – locally sourced biomass pellets – and allows consumers to lease a more expensive and very high quality Fan-Gasifying stove. Rural consumers may provide biomass as part or all of their payment for the stove lease, and Inyenyeri converts the raw biomass into the processed pellet fuel. Consumers purchase fuel from Inyenyeri (in cash or by exchange of bulk biomass), and also receive free repairs and maintenance as part of the stove lease. This not only addresses the barriers of upfront costs and maintenance/quality problems, but also provides a more sustainable business model for the supplier because of the ongoing revenue streams.

Inyenyeri is seeking to use carbon finance as a tool to upscale their business model. After a successful pilot phase from 2010 to 2014, where they distributed more than 1,300 stoves by the middle of 2014 and sold 50,000 verified emissions reductions (VERs), they are expanding pellet production and exploring options for carbon finance to support this expansion. The company is hoping to leverage an ERPA to attract both equity and debt financing.

Source: www.inyenyeri.org and Ci-Dev PIN for Rwanda Inyenyeri PoA

Successful energy access programmes may access capital from private investors, such as in the Ugastove programme (see Box 8 and Climate Care (2013)), but this capital is often scarce, particularly in low income countries. Some donors have provided early stage grant funding to CDM projects, where these disbursements were then repaid from proceeds from the sales of the first CERs (Ci-Dev, 2015). The Global Environment Facility (GEF) has provided concessional financing to mitigation projects through an **equity investment fund**, such as the one led by the African Development Bank for the "Africa Renewable Equity Fund". The GEF concessional funding served as an "equity cushion", and allowed $29.5 million (including $4.5 million from GEF) in public funds to leverage $150 million of additional funding (Ci-Dev, 2015).

Equity investment funds for CDM RBF programmes could operate in parallel to the CER contracting and capacity building functions, to ensure that the energy access programmes supported could reach sufficient scale rapidly. These financial instruments could also have triggers for replenishment, but they would not be results-based in the same way the performance incentives discussed above would be. The reality of the energy access challenge is that, without growth of successful businesses, the "Sustainable Energy For All" targets will not be met, and the availability of "risk capital" is a critical barrier. The more that equity and debt financing tools can be linked to CDM RBF schemes, the more effective those schemes will be.

Box 8. Ugastove – use of private capital and the voluntary carbon market

Ugastove grew out of a family business and was launched in 2005 with a grant from the US EPA and private capital. Ugastove uses the proven "rocket technology", which consists of an insulated elbow-jointed combustion chamber to increase combustion efficiency and retain heat, while also raising the cooking pot to the hottest point above the flame. More than 200,000 stoves were sold between 2007 and 2012, mostly in the Kampala area, and production has reached 9,000 per month. Ugastove markets both household appliances and also institutional stoves for use in schools. The programme was not eligible under the CDM when it was initiated and so was one of the first to use a methodology under the Gold Standard for Verified Emissions Reductions (VERs). As one carbon market expert notes, "an innovative ERPA was signed with ClimateCare which paid for a proportion of the VERs at the start each year and the balance on delivery." Carbon revenue has been used to subsidize the cost of the stove, to improve mechanisation in production, and to support community activities. The programme was issued VERs for more than 900,000 tCO_2 between 2007 and 2012, and ClimateCare continues to market the VERs.

Sources: ClimateCare (2013), Practical Action

One possibility for linking RBF incentives with other project financing instruments, as well as capacity building and improving the national enabling environment, is to **bundle these activities within a broad national-level mitigation programme** such as Nationally Appropriate Mitigation Actions (NAMAs) or a similar new instrument that could be included in the new climate change agreement in Paris this year. NAMAs are defined under the UNFCCC and refer to any action taken by developing country Parties that reduces emissions and is prepared under the umbrella of a national government initiative. They can be policies directed at transformational change within an economic sector, or actions across sectors for a broader national impact. As an example, a NAMA covering access to clean cooking could include various RBF incentive schemes (domestic or international), policy development at a national level to promote access (e.g. pricing and tariff reform), developing technical standards and testing centres, and investment funds that pool public and private capital to support energy access businesses.

Under the UNFCCC, NAMAs are to be supported and enabled by technology, financing, and capacity-building, but up to now funding to undertake these activities has been very limited. So far nine NAMAs have been supported, and financing for these has come from bilateral funds from countries such as Austria, Japan and the UK or through facilities such as the GEF. None of the nine supported programmes appear to have any energy access component, but the future depends entirely on the appetite of the donor community to support these initiatives. So, on one hand, NAMAs have not yet received significant flows of funding, but, on the other hand, they are the only sectoral or national mitigation instrument that is currently operational under the UNFCCC. They provide a portal for linking funding needs and funders, and international recognition of both the mitigation actions and the contributions to support those actions.

Whether the form of national mitigation programmes changes as a result of this year's new climate agreement, the point here is that country ownership and scope for national implementation make national mitigation programmes an attractive home for energy access programmes with mitigation impacts. Such national programmes could include project financing, structured funds, promotional loans, development loans, grants, equity instruments and guarantees. In addition, the dialogue between host countries and potential funders could ensure that the enabling environment was addressed prior to the launch of CDM RBF initiatives within the overall programme. This is similar to what has occurred in the Senegal rural electrification programme, presented earlier, where the concessions have been supported and financed by a variety of donors, implemented by private sector companies, and a CDM PoA is being developed under the umbrella of this organisation. A national mitigation programme could also include the development of country-specific standardized baselines and standardized monitoring approaches, which could support a variety of CDM RBF schemes within the sector.

Although sources of financing for national mitigation programmes such as NAMAs have so far been limited, the expected scaling up of **financial support under the UNFCCC** and a new climate change agreement in 2015, including the operationalisation of Green Climate Fund (GCF), could represent a substantial new source of support for sectoral-level energy access programmes and for a range of RBF initiatives for energy access. As an example, the GCF “initial results management framework”, which describes how the impacts of the GCF will be measured and reported, includes, as one of the proposed indicators, the “number of households, women and men with improved access to low-emission energy sources”, as well as in indicator on increased low-emission energy generation capacity (GCF, 2014). The GCF is, in a sense, the benchmark for broader climate-related financing, both because of its potential size and also because it will be an international standard for funding decisions. The GCF is also considering the range of financial instruments that might be applied in climate finance.

The importance of **multiple instruments** and **blended financing** (e.g. combination of RBF with other financial tools, such as grants, loans and guarantees) is clear, although how to attribute the results of these different instruments could still present challenges. The development of results management frameworks for these financing channels also highlights the critical need for relevant indicators, and **recognised international standards for impacts other than GHG reductions**, especially if these other benefits will be used as triggers for RBF payments.

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Box 9. Nordic experience with ERPAs and project financing

A 2010 workshop organised by the Nordic Council of Ministers on "The Role of Public Finance in the Carbon Market" concluded that:

- The ERPA does not, due to the risk of registration and issuance delays or failures, have the same value as a power purchase agreement for electricity – debt providers do not necessarily recognize an ERPA as collateral.
- The value of ERPAs, whether in CDM or Joint Implementation (JI), varies between actors. In a system where carbon finance income would be more predictable and the share of income would be larger, the significance of an ERPA would be higher. The value of an ERPA seems to range from marginal to something that is important as part of the whole financing picture.

Some examples of ERPAs and financing were highlighted, including the following:

- During the earlier years of the Danish JI and CDM programme, they worked with projects in the early phases of development and signed ERPAs with projects that were not yet fully financed, but this had largely changed by 2010;
- Finland reported that an ERPA was signed once at an early stage in order to provide collateral;
- The Norwegian programme had signed some ERPAs that were used as collateral when the project owner applied for a loan;
- The Swedish JI and CDM programme would sign an ERPA only if they saw that the project is likely to be fully financed;
- Norfund explained that they did not always view ERPAs as a collateral for financing, although EKF (Denmark) accepted an ERPA as collateral;
- NEFCO argued that the ERPA is one of the securities they consider.

Source: TemaNord (2011)

3.5 Summary

Table 3 below summarises where CDM RBF can directly and indirectly impact the elements of successful business models, and where complementary financial instruments will increase the effectiveness of the RBF scheme. An "indirect" CDM RBF impact is where the criteria for selecting recipients for CDM RBF contracts influences the actions of agents, and potentially the governments of the countries that could host programmes. The column "Policy/ODA" refers to more traditional donor aid to the energy sector, both for policy and regulatory development and for institutional and capacity building. The "capital" column refers to equity financing, revolving funds, concessional loans and public-private partnerships for providing capital. The strongest direct impacts from CDM RBF will be on cost structure and cash flow, particularly for cook stoves, and the standards and consumer acceptance aspects of the enabling environment. In addition, some of the eligibility criteria for countries or participants or dissemination of best practices can also impact on efficiency and structure, and the policy aspects of enabling environment. Complementary instruments will be most effective in addressing the policy side of the enabling environment, while instruments that specifically address upfront capital requirements are crucial to address this success factor for growing energy access businesses.

Table 3. The impact of CDM RBF and other instruments on elements of successful business models for energy access

	CDM RBF		COMPLEMENTARY INSTRUMENTS	
	Direct	Indirect	Policy/ ODA	Capital
Enabling environment				-
- Policy, tariffs, import duties	L	L	H	-
- Standards, awareness	M to H	M to H	H	-
Cost structure, cash flow				
- Solar devices	L	M	-	H
- Cook stoves	M to H	M	-	H
- Grid, mini-grid	L	M	-	H
Efficiency and structure	L to M	L	M	L
Access to capital	L	L to M	L	H

Note: L = Limited impact, M = Moderate impact, H = High impact

Now that it is clear that CDM RBF *can* support certain elements of successful business models, the next question is *how* to design a scheme most effectively, including how to package the RBF components with other non-RBF financing instruments. The next chapter looks at one key aspect of this: how to design the structure of the CDM RBF incentives - the metrics used for results, price setting for those results and structure of payments. This is then followed by a discussion in chapter 5 on how CDM reform can reduce the transaction costs and increase the predictability of delivery of CERs, the key result from RBF mitigation projects.

4. Structuring the incentive: measurement, price setting, and payment structure

This chapter explores additional metrics or "triggers" for payment beyond CERs in a CDM RBF instrument, which could relate directly to energy access goals. This continues with an assessment of different price setting strategies, and their implications for CDM RBF, as well as a discussion of how to structure payments to get the best energy access results.

- While CDM RBF would primarily use CERs as the verified results against which payments are made, there is a clear trend in climate financing to include additional metrics for performance other than just GHG reductions. For energy access, this could be the usability of the energy services – measured as an index or tier level - or the actual energy consumption levels.
- A key benefit of the CDM system is that it can provide credible long term MRV for RBF schemes, specifically for quantifying GHG impacts.
- Auctions have distinct advantages for price discovery, particularly when compared to the transaction costs and capacity needed for administrative pricing. However, certain administrative pricing approaches, such as component costs and barrier costs, could provide an alternative that could be both cost-effective for funders and catalytic for energy access markets. Administrative pricing also provides an opportunity for valuing non-GHG benefits and paying for multiple results by energy access programmes. Linking CDM RBF pricing to other markets can also work well, as long as these markets are well defined and robust, which is currently not the case for trading platforms for CERs.
- While most contracts for the purchase of CERs have been for payment on delivery (e.g. forward contracts or spot market transactions), results-based approaches in the energy sector vary widely in the structure of their payments. Payments may be front-loaded to the degree that the operation of the technology is low risk and/or has low ongoing costs.

4.1 Choosing the right metric

As discussed in the introduction, the assumption in this paper is that CDM RBF will, at least initially, primarily use CERs as the verified result against which payments are made. However, there is a clear trend in the climate financing world to consider metrics other than just GHG emissions reductions. The initial performance management framework for the GCF, for example, includes as indicators for mitigation projects the number of new households with access to low-emission energy sources, number of low-emission power suppliers, and capacity of renewable energy installed (GCF, 2014). In addition, it will be easier for CDM RBF schemes to find synergies with other funding streams serving the energy sector, and energy access in particular, if the MRV system for the scheme also addresses measurement of energy access directly. Finally, CDM RBF schemes can more easily be linked to national mitigation programmes or sectoral initiatives (which could support the enabling environment and capacity aspects of successful business models) if their indicators are in line with host country priories and not only global priorities (Winkler and Dubash, 2015). This short section considers what those additional metrics could be and how to apply them.

The ESMAP (2013) report highlights three criteria for choosing an appropriate indicator for RBF payments:

- **Proximity to ultimate objective**: whatever result is being measured should ideally be close to the actual objectives of the programme, which will not only be GHG emissions reductions. For example, if the objective of an improved cook stove programme is, in part, to improve health, but the only measure is the number of units sold in the country, there may be many other factors that influence the results. This relates to the concept of the "energy results chain" (ESMAP, 2014), which applies Logical Framework Analysis to the energy sector, and moves from "inputs" all the way to "impacts" (see Table 4). Traditional financing for energy access often only considers inputs and outputs, and even some results-based financing approaches only use outputs. However, generally the goals of the funder – and the recipient – are higher up the results chain. The higher up the measurement is, the more likely the program is to deliver the desired results. Table 4 provides examples of energy access results that are further up the energy results chain, across different technologies.

Table 4. Energy results chain applied to energy access technologies

Results level	Electricity	Improved cooking	Productive uses
Impacts	Impacts on poverty, education, health, environment		
Intermediate Impacts	Consumption, appliance ownership, EDI	Energy service use, Increased income, time savings, EDI	Productive output
Outcomes	Usability (e.g. ESMAP index), Tiers of service	Usability, Tiers of service	Usability
Intermediate Outcomes	Attributes (hours available, reliability, quality, etc.)	Hours saved, better fuel access, less pollution	Attributes (hours available, reliability, quality, etc.)
Outputs	Capacity	Units distributed/ available	Capacity
Inputs	Loans, Equity & Grants, Private Sector Participation, Budget Allocations		

Source: Adapted from ESMAP (ESMAP, 2015a, 2014); EDI = Energy Development Index

- **Provides an appropriate and clear incentive**: a clear, well-articulated goal will marshal more support and action. The national goals for an energy access programme will not, typically, be GHG emissions reductions, but rather increased service levels for poor communities (Winkler and Dubash, 2015). This may sometimes create a tension with the first criterion, because development impacts are not only more complex to measure but also more difficult to directly link to energy access programme activities. "Appropriate" also means that the recipient has significant influence over the result, so that they can respond to the incentive. Private sector and

NGO implementing agents may be able to directly influence outcomes, and in some cases intermediate impacts, but will have less control over impacts.

- **Is feasible to measure:** one of the main reasons why inputs (e.g. funding disbursed) and outputs (e.g. units distributed) are used so frequently is that they are relatively simple to measure. Given the need to move up the energy access results chain, indicators for intermediate outcomes, outcomes and even impacts are needed. Significant progress has been made in recent years on measuring the usability of energy services through household energy surveys, and combining various attributes into "tiers" of energy service. Figure 2 shows how the various attributes are integrated into a tier measure for household access to electricity, while similar matrices are available for cooking and other services. The measurement for the overall programme could, then, be based on targets for the number of households that achieve each tier level, or positive changes in tier levels.

Figure 2. Multi-tier matrix for measuring household access to electricity

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	No electricity	1-50W	50-500W	500-2000W	>2000W	
Duration	<4hrs	4-8hrs		8-16hrs	16-22hrs	>22hrs
Reliability	Unscheduled outages				No unscheduled outages	
Quality	Low quality			Good quality		
Affordability	Not affordable		Affordable			
Legality	Not legal			Legal		
Health & Safety	Not convenient				Convenient	

Source: ESMAP (2014)

One of the benefits of an MRV system such as the CDM is the ability to measure the consumption of energy, and to do so on an ongoing basis during the programme. Consumption is generally considered an "intermediate impact" and is therefore relatively high on the results chain. Consumption is measured not only in the electricity methodologies[9], but also the primary methodology for cook stoves (i.e. AMS II.G), which provides several approaches to quantifying biomass use and savings over the life of the project. The energy access methodologies also have provisions to confirm that devices or connections are still operational in each year of the project life (an "intermediate outcome"), and not allowing any crediting for units that have failed and not already been replaced or repaired. More recently, when methodologies are revised by the EB they include "non-binding best practice" examples

[9] While AMS I.L does allow for "deemed consumption" from stand-alone renewable energy systems, the methodology requires ongoing checks for continued operation of all units, and uses conservative default values for renewable energy production and consumption.

of the GHG calculations. This same approach could be applied to non-GHG triggers as well, with guidelines for measurement being provided as part of the methodology.

One other consideration on "triggers" is that a CDM RBF scheme may have more than one trigger for payment, depending on the goal of the funders supporting the scheme. Currently there are many donor-funded programmes that target energy access but do not buy CERs or measure the GHG impact. Including both access and mitigation indicators as triggers for payment could provide an opportunity to consolidate different funding programmes for greater impact, by exploiting synergies in planning and implementation. Different incentives could be provided for different technologies or capacities, or the incentives might be different for installation versus operation. For example, a programme might provide $200 for each new electricity connection, but an additional $100 if the household reaches Tier 3 service level. Or one payment could be for CERs generated and a second could be for achieving a certain tier of energy service level. This also opens the possibility of providing an additional incentive for higher level and quality results, which might be measured later in the project life, and for explicitly stating the funder's willingness to pay for different types of results.

Once the metrics are agreed, then the funder and recipient(s) must agree on a price level for the incentive. Broadly speaking, there are three approaches used for RBF price setting in the energy sector and in the carbon financing world. These are *administrative pricing, auctions and links to another market price* (e.g. linking CER prices to European Union Allowance (EUA) markets). These are described in the sections below, along with some of their benefits and challenges.

4.2 Administrative price setting

The basic idea of administrative price setting is that the buyer and seller agree on a price based on data and assumptions about the costs and benefits of a particular project or programme and, in some cases, the preferences or characteristics of the buyer and seller themselves. This may take several forms:

- **Incremental cost analysis**: The first climate finance instrument – the Global Environmental Facility (GEF) – used the principle of incremental cost to establish pricing levels. The incremental costs were determined by assessing the full range of costs and benefits of the intervention relative to the costs and benefits of the "business as usual" (BAU) scenario. The BAU scenario was to describe, "the situation or context relevant to the proposed project intervention in a country or proposed project site as it would expectedly unfold." (GEF, 2007) BAU was to be analysed, "in terms of the objectives and outcomes that might be achieved, and the quantitative (e.g. budgets and planned expenditures) and qualitative (e.g. institutional capacity) inputs that would be forthcoming regardless of whether the GEF intervention occurs or not." (op. cit). In practice, many proponents struggled to clearly identify the BAU alternative, and to provide the documentation and argumentation to justify that BAU was different from the project (GEF, 2006).
- **Investment analysis**: In contrast to the incremental cost approach, many early buyers of CERs, including the first-mover Prototype Carbon Fund (PCF), used the impact of carbon

revenue on the investment performance of the project, typically Internal Rate of Return (IRR) or Net Present Value (NPV), as an input to pricing or to evaluate their portfolio. Because there was no liquid market for emissions reductions at the time, this approach provided a framework for evaluating appropriate payment levels. The alternatives to the project were not analysed directly, but were rather reflected in the market prices for co-products (e.g. electricity sales) and the opportunity cost of capital for the project owner. The carbon price would then be set, in part, to ensure that a project that previously was not financially viable would now become viable because of the payments, taking into consideration the risks inherent in these early-stage transactions (Kelly and Jordan, 2004). This same logic was behind the tools and guidance documents approved by the CDM Executive Board for demonstrating “additionality” and setting baselines, where this type of investment analysis was one (and often the most important) part of the justification (Schneider, 2009). This has also been one of the most controversial areas of the CDM (Ellis et al., 2007; Gillenwater and Seres, 2011), with many critics arguing that the approach was so inherently subjective that it was unlikely to be accurate (Gillenwater, 2011; Gillenwater and Seres, 2011; Schneider, 2009; Spalding-Fecher et al., 2012).

- **Economic evaluation**: another approach to set prices is to consider more formally the Willingness to Pay (WTP) of the funder of the RBF scheme and the Willingness to Accept (WTA) payment of the project implementer, based on their preferences and constraints (Hicks, 1946). This range would then set the boundary within which the two parties would negotiate (assuming the WTA is less than the WTP), instead of this range being set arbitrarily. In the context of energy access programmes, the buyer’s WTP might be understood as their willingness to support certain development outcomes, as evidenced by their expenditure on similar programmes (although possibly in other sectors) in a variety of countries (ESMAP, 2015a). If the recipient is a private company or independent non-governmental organisation, then their WTA will depend on the marginal cost of the intervention (i.e. relative to an alternative), as well as whatever value they place on achieving the outcomes for their own reasons. If the recipient is a government, then their WTA will include the assessment of marginal cost, the value they place on the outcomes (which also may be demonstrated by spending in other sectors), less any other outside financial support they are already receiving for the programme (ESMAP, 2015a). A government’s WTA may also reflect positive externalities from the intervention (e.g. public goods in health, education, and public safety), that would not normally be included in a financial analysis or incremental cost analysis (Eyre, 1997).

  While this model is appealing, and could provide a more principled basis for a negotiation, it also faces several challenges. Determining the value that a funder or recipient places on the development outcome is difficult in practice, both because similar benefits may not be quantified across sectors and programmes, and because most programmes have multiple outcomes. The outside financial support could also change suddenly, after the pricing had already been agreed. As discussed in the previous points, even determining the marginal cost of the intervention is not straightforward, because it requires an economic understanding of the alternatives. Finally, because of the relative power of the two parties, even if the WTP and WTA are easy to establish, it could be difficult for the recipient to negotiate a price well above their WTA and capture a significant share of the potential surplus.

- **Barrier cost/component cost**: a more recent approach to administrative price setting is to estimate the cost of specific components of a programme or the costs of removing key barriers to implementation.[10] The concept here is that there may be certain actions that, while not providing all of the necessary financing to make a programme viable, have a catalytic effect that unlocks other sources of financing or benefits. Identifying these costs may require additional due diligence, to understand what actions will be catalytic for the programme. For example, in the energy efficient lighting programmes under the CDM, the costs analysed are often the overhead costs of the programme, as well as any costs of bulbs that will be distributed for free. While this ignores the energy savings to consumers that would form part of an economic analysis, the programme overheads are able to address market barriers (e.g. lack of consumer awareness, lack of technical quality standards) that unlock different consumer purchasing decisions. Similarly, some solar projects in the Ci-Dev pipeline have identified battery replacement as a key barrier to the sustainability of off-grid electricity access programmes. Other examples would be a contribution to other maintenance costs, monitoring & evaluation for the overall programme, and the costs of training and institutional building among recipients (e.g. see Box 5 and Box 6). Funding only a particular component may mean that less overall donor resources can be used to support the programme, while still enhancing its success and sustainability. However, the major conceptual challenge with this approach is that it does not address the question of a baseline. If there is the possibility that the programme could have been implemented without this more modest financial support (i.e. compared to using the investment analysis approach described above), then funders may be providing incentives for action that could have happened anyway.

For all of these options, the detailed data involved does mean that they are country-specific, and in some cases funder-specific as well. The pricing strategy can therefore be tailored to the particular needs of the programme and the enabling environment. The time and cost to undertake these approaches, however, presents a challenge for upscaling CDM RBF. This level of due diligence implies both significant overhead costs as well as long funding cycles. Generic costs are useful in setting sectoral benchmarks or incentives, as long as the trends (e.g. trends in lighting device costs) are closely monitored, but these may not be sufficient to understand the economics of projects at the country level. On the other hand, an administrative approach does allow the funder to directly value other benefits (e.g. health, education) and pay for these higher level “impact” results explicitly.

4.3 Auctions[11]

An alternative to administrative pricing is to create an “auction” where the potential suppliers of energy access services and GHG emission reductions bid to receive support from

[10] Although many of the GEF programmes focus on barrier removal, this was not generally used to determine the pricing of the environmental benefits of the programme.

[11] This sub-section draws extensively on (ESMAP, 2013)

principals who want to subsidise those outputs. Auctions are a way of introducing competition in a new market and allocating subsidies efficiently: different actors could bid for the amount of subsidy they would require to deliver certain energy access and mitigation outcomes, at prescribed quality levels. The principal could then choose the agents requiring the least amount of subsidy to deliver the desired results. Because the bidders win by offering a lower price, this is called a "reverse auction", similar to what the Pilot Auction Facility launched in July 2015[12]. An alternative would be that the funder fixes the size of the subsidy, and then bidders then compete to offer the highest results, as in the Senegal rural electrification programme (see Box 6).

Auctions will work best when there are sufficient qualified players in the market to encourage competition to deliver the result. The global expansion of the efficient lighting, solar lighting, and cook stove markets are all examples of this, because there are now significant numbers of regional and international players in these markets. They can also be useful to open up a new market, where the market power of an incumbent (e.g. state-owned utility or early entry operators with state support) could discourage rapid change in the market. This could be the case for grid electrification, and mini-grid if this is also regulated similarly to grid and subject to market power challenges. Auctions are also price discovery mechanisms, which eliminate the need for the detailed "bottom-up" cost analysis for energy access and GHG mitigation described in the previous section. The long term success of an auction depends in part on the dynamics of the sector, and whether there could be major shifts in project economics after the conclusion of the auction. The classic "winner's curse" is a situation where an agent wins an auction by bidding too aggressively, and then cannot actually deliver for the agreed price (Butler and Neuhoff, 2008). This is most likely in markets with new technologies where costs are uncertain and/or the agents are less mature businesses. The risk faced for agents in "greenfield" auctions (i.e. for projects that have not been implemented) is greater than under an auction that focuses on projects partially implemented or stalled due to lack of carbon revenue, because of the time required for implementation and various policy and implementation risks. This means that the auction prices demanded by agents may be higher, to offset their additional risk and because they do not yet have any "sunk costs" the way ongoing projects would.

One additional challenge for auctions is that, when the winning bids are very low compared with the marginal costs of the interventions, there may be a higher risk of free riders, although using CDM baseline methodologies can address this for many projects[13]. At the same time, auctions can be used to provide incentives for higher level results (e.g. intermediate impacts) and for valuing development benefits other than GHG emissions reductions, as long as there is a methodology for quantifying that result; and auctions can do this without the principal having to understand the detailed costs and benefits of achieving the results as in the administrative pricing model.

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[12] http://www.pilotauctionfacility.org/

[13] Whether the existing CDM methodologies and rules adequately screen out free riders (i.e. non-additional projects) is still a source of controversy, although less so for energy access projects.

4.4 Link to other market prices

The evolution of exchanges and other visible trading platforms for primary and secondary CERs, and the link between the EU ETS allowance market and the CDM, meant that results-based funders in the CDM market could set prices based on a linked market price (i.e. an objective, publically available market price). These linked market prices also reflected the buyers' Willingness-To-Pay for the GHG benefits, because their alternative to investing in a given project was to purchase a similar commodity in another market. This worked well when prices were high, but as the supply of CERs started to exceed demand after the economic crisis in Europe and with no international climate agreement to drive future demand for CERs, these benchmarks also lost their value. It would certainly not be correct, for example, to say that $0.50 per CER (World Bank, 2014 p. 17) represents the real value that donor countries place on climate change mitigation. The conclusion of an ambitious new international agreement in Paris in December 2015, and one which recognises CERs as an instrument that can be used for compliance with emissions reduction commitments, could revive these carbon markets, but this is not a guarantee and, as has been discussed throughout this report, GHG benefits are not the only reason that countries fund energy access programmes. In some cases, there could be other market parameters that can be linked to the development benefits. For example, if improved health outcomes reduce the number of days of lost work due to illness, then lost wages can be used as a proxy for part of the development benefit of improved health (Spalding-Fecher, 2005).

Another example is the direct benefit of time savings for women as a result of improved biomass cook stoves (i.e. less time spent gathering fuel). The "W+" standard[14] provides a quantification methodology for this benefit and also markets the resulting units. For the first programme – a biogas programme in Nepal - the units (i.e. one hour saved) sell for $2.40. This is equivalent to $27 per t$CO_2$ reduced, if the payments were applied to the CDM-based emissions reductions. Similarly, a study by Imperial College London for the International Carbon Reduction and Offset Alliance (ICROA) found that for a portfolio of projects in the voluntary carbon market the combination of local environmental benefits, impacts on employment and health, and the savings in fuel costs had a value of more than $600 per t CO_2 reduced (ICROA, 2014). There are also proposals to create markets for other benefits[15], such as health benefits quantified as avoided "disability adjusted life years" (DALYs) (Carrasco et al., 2013). These examples all highlight the importance of identifying and/or **creating markets for development benefits**, not only at the international level but also potentially at the national level as well.

Table 5 below summarises the pricing approaches discussed in the preceding sections, as well as providing examples of where these are used both in carbon finance and in the energy

[14] www.wplus.org

[15] In an example outside of the energy access field, a valuation of benefits of household waste composting showed that the increased agricultural yields delivered by organic fertilizer products from this programme were worth the equivalent of almost $100 per t$CO_2$ reduced. (Santucci et al., 2014)

sector more broadly. The impact of payments through a CDM RBF scheme depend not just on the value per unit of results (e.g. CER or energy access metric), but also on the timing and structure of the payments, which is the subject of the next section.

Table 5. Alternative pricing approaches

	Administrative	Auction	Link to other markets
Why to use	When there is good competition in market (if only a few players, could negotiate bilaterally) Where costs are well known	If there are concerns about market power If quantity guarantee needed As form of price discovery	Transparent, to reduce transaction costs and capacity requirements
Risks or drawbacks	Windfall profits, free riders Need capacity to do the analysis – high transaction costs Market environment may change quickly	Winners underbid and are not actually viable due to market changes Need capacity to run auction	Market may disappear (e.g. CERs) – or incentive may not be sufficient for action Price volatility
Examples	Lighting subsidies Ci-Dev payments for CERs Feed-in Tariffs for many renewable energy technologies	South Africa Renewable Energy IPP procurement[16] , Norway CER procurement[17], Senegal rural electrification concessions, Pilot Auction Facility	CER market price, time savings for women, avoided DALYs

4.5 Structuring RBF payments

While most contracts for the purchase of CERs have been for payment on delivery (e.g. forward contracts or spot market transactions), results-based approaches in the energy sector vary widely in the structure of their payments, with some payments upfront and others at different stages of project implementation. Table 6 illustrates some of the options for the **timing and conditionality of payments**, along with relevant examples. Note that for any projects that include payments during operation, there would be an additional decision of what ***share* of the total expected payment** is made at each time interval. For example, the Uganda GET FiT programme has a renewable energy premium, which is calculated over 20

[16] http://www.ipprenewables.co.za/

[17] http://www.nefco.org/financing/nefco_norwegian_carbon_procurement_facility

years but is paid out 50% upon commissioning and 50% over the first five years of successful operation (GET FiT Uganda, 2014). The rationale is that, after five years of successful operation for a capital intensive technology, the risk of non-performance in subsequent years is very low. Even if the initial project owner went bankrupt, the asset is too valuable for someone not to operate it and generate both power and emissions reductions. This would be particularly true with medium to large scale renewable energy technologies that have essentially “free” fuel (e.g. wind, solar, and possibly ocean/tidal). To put it more generally, payments may be front-loaded to the degree that the operation of the technology (and delivery of the energy services) is low risk and has low ongoing costs.

Table 6. Options for timing and conditionality of payments

	Contract signature	Investment	Investment & operation	Operation only
Description	Part of payment delivered on signing of RBF agreement	Payment when installation or distribution is complete – system is available	Payment based on verified operation and use of the system, following the installation or distribution	Payment for operation, but project owner not responsible for installation
When to use	When need for upfront capital is main barrier to success	Operation difficult to measure, or capacity alone is sufficient to achieve goal	To get closer to verifying outcomes/ impacts instead of just inputs and outputs	Asset is pre-existing or recipient does not have control over investment
Examples	CDM ERPAs with a share of upfront payment Energy efficiency housing audits	Bangladesh SHS re-financing Solar lighting outside of CDM Cook stove RBF outside of CDM	Typical CDM ERPA (long term) Uganda GET FiT premium payments (short term)	Performance management contract for power plant

Source: adapted from ESMAP (2015a, 2013) reports

As discussed earlier, one challenge of developing an RBF scheme is matching a payment structure that is effective for recipients, in terms of incentivising action, with a public sector funder’s need for predictable cash flows and often shorter-term time horizons. A revolving fund is one important tool for structuring a financial solution, because it allows the funder to contribute agreed lump sums according to relevant national budget timeframes, but for the payment to be disbursed only when the RBF criteria are met. This works particularly well when the incentive being provided is concessional financing rather than an outright grant, since the loan repayments come back to the fund and allow for more activities to be incentivised. In addition, the replenishment of the fund could also be linked to the aggregated results of the RBF scheme (e.g. number of new connections achieved in a certain period of time), ensuring that the funder commitment would only be expanded as concrete results were achieved. In another mitigation area, the Pilot Auction Facility for Methane and Climate Change Mitigation (PAF) is also testing the use of tradable bonds that represent a “put option” for future sales of emissions reductions. These options specify a future price at which the project owner can sell CERs, by redeeming the tradable bond. This means that the funder only disburses payments once the verified results are achieved, and only if the project owner decided to redeem the bond (which they will not do if market prices rise higher than the price guaranteed by the put option).

For payments based on CERs, the CDM methodologies provide a **baseline** for emissions, so that CERs are not awarded to “free riders” who would have acted even without the CDM incentives[18]. If other energy access metrics are included in the CDM RBF scheme, they will also require a baseline, which is sometimes overlooked. The baseline for the non-GHG metrics should reflect the underlying trends in energy access, including the penetration of low carbon sources of energy (e.g. improved cook stoves, solar home systems). For activities that are considered automatically additional under the CDM (e.g. improved cook stoves[19], solar technologies, rural electrification when access rates are less than 20%, very small renewable power technologies in the poorest countries), the current situation for energy access could be taken as the baseline (i.e. no additional growth of these technologies would occur without the CDM RBF initiative). For some other situations, however (e.g. grid extension in countries with more than 20% rural access rates), creating a baseline would be more complex, because it would need to reflect not only the current variation in the quality of access but also national programmes and initiatives already funded that would increase access. This might be evaluated as part of developing a Standardized Baseline under the CDM, or planning with alternative donor support, which could be part of the CDM RBF initiative. Depending on the preferences of the funder, not accounting for these changes may not necessarily be a problem, if they are willing to subsidise all increases in access from the current situation. Some funders, however, may want to ensure that the incentives are catalysing activity that would not have occurred, in part to use scarce public resources most efficiently.

All of the discussion of pricing and payment structures relies on an underlying assumption that the recipients of CDM RBF payments have a reliable system to deliver the “trigger” for payment. But the issuance of CERs is not a foregone conclusion for energy access projects entering the CDM pipeline, and there may be significant delays between the delivery of energy services (e.g. the distribution and use of improved cook stoves) and the issuance of CERs. The credibility of a CDM RBF system will be enhanced by increasing the predictability of the CDM system and streamlining the processes so that CERs are delivered as soon as possible after the activities occur. This is the subject of the next chapter.

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[18] How effective the CDM rules are in eliminating free riders has, however, been one of the most controversial issues in the debate on carbon market mechanisms (Ellis et al., 2007; Gillenwater, 2011; Schneider, 2009; Spalding-Fecher et al., 2012).

[19] Cook stoves are not listed as a specific technology that is automatically additional, but would qualify because they are independent units that have energy savings less than 3000 MWh-equivalent.

5. Enhancing the predictability of the "trigger": CDM reform and beyond

For CDM RBF instruments to be effective in any of the roles described in chapter 3, the CDM process must not only provide a trigger for payments, but do so in a timely and transparent manner. An incentive that is uncertain or delayed, even when the energy access goals may have been achieved, would undermine the entire CDM RBF scheme. This is why simplification and streamlining the CDM can have a positive influence on the success of CDM RBF instruments. CDM reform targets the "cost structure and cash flow" element of successful energy access programmes, by reducing the transactions costs and time required to deliver CERs, as well as reducing the uncertainty associated with CER generation and potentially increasing cash flows (i.e. if CER generation per household increases). In addition, some CDM reform could reduce the need for access to business capital, by making it easier for project owners to receive upfront payments, as discussed in the previous chapter.

The CDM Executive Board is making progress in simplifying and streamlining the CDM system, which will enhance the credibility of CDM RBF schemes by reducing the uncertainty associated with CER generation. Additional reforms that would benefit energy access programmes include the following:

- Simplify the CDM MRV process: data collection at a sectoral level, and aggregated monitoring at a higher level than each PoA could reduce transaction costs and actually increase accuracy. Revising the magnitude and timing of registration and issuance fees could also improve cash flows for energy access programmes, particularly in the current depressed carbon market.
- Expand and simplify SBs: Allowing the use of more default values and recognising data that is already available for the sector would reduce the transaction costs and time required for delivering CERs, as well as reducing risk. Incorporating guidance on minimum service levels in the SB rules and including service *quality* as a criterion when evaluating alternative technologies in the SB justification process would also reduce costs and could also increase carbon revenues.
- Pre-issuance of CERs: Pre-issuance of a portion of the first monitoring period CERs at registration, instead of waiting until after verification to issue any CERs would reduce energy access programmes' need for capital, since more funding (i.e. from the sale of pre-issued CERs) would be available upfront.
- Simplify the CDM project cycle: Creating a standardized registration process or, for CPAs, a standardized inclusion process, for project types that qualify for automatic additionality could dramatically reduce the transaction costs and time delays for these project types. A checklist approach could be used for registration, with all project design and performance parameters confirmed by the DOE at first verification.
- Explore how CDM methodological approaches can be broadened to a sectoral or aggregated crediting: to broaden the scope of the CDM to a sectoral level, new methodological approaches are needed. The practical challenges will be establishing a baseline for consumption at an aggregate level and finding a way to capture the diversity of household access levels and previous energy use patterns in a highly aggregated measure of access. Even though this is not currently possible under the CDM rules, RBF funders could propose such approaches using their own pipeline of projects as case studies of the options for setting these more aggregated baselines and emission reduction calculations.
- Revising CDM methodologies to include energy access parameters beyond GHG emissions reductions, and developing standardized monitoring approaches, would open the possibility of using the CDM system as an MRV tool for other RBF instruments.

In May 2015, the CDM EB agreed on an action plan for simplifying and streamlining the CDM[20]. The main themes of this plan are summarised in Box 10, and cover most of the areas proposed to the EB by the Secretariat. Based on the inputs from stakeholders, which were summarised in the Secretariat's note, this list of themes has the potential to significantly improve the timelines, certainty and transaction costs for the CDM. In addition, a parallel

[20] CDM EB84 report, paragraph 6.

process on digitization of more CDM forms and processes could also make it easier for new programmes to move through the project cycle.[21]

Box 10. EB action plan on simplification and streamlining of the CDM

The EB has asked the Secretariat to prepare concrete proposals in the following areas;

- Project registration and implementation: considering innovative and more efficient approaches to additionality; increasing flexibility for monitoring plan changes during project life
- Validation and verification requirements: simplifying "means of verification" to rely more on DOE judgement; expanding the materiality concept to verification, as well as validation of PoAs; allowing the same DOE to do validation and verification
- Other steps in project cycle: reducing the number of steps and timelines across the project cycle; providing a faster and simpler project cycle track for projects with low environmental risks; streamlining post-registration changes
- Baseline methodologies: making methodologies and tools more user-friendly; reducing the steps and timelines for new and revised methodologies and standardized baselines.
- Third-party verification bodies: making the quality assurance system proportionate to risks; exploring synergies with other international standards

Source: adapted from EB84 report

In addition, there are several proposals for CDM improvements that were in the Secretariat's note[22] to the EB that have not yet been included in the work plan, but could reduce timelines and increase certainty. These include: greater flexibility in host country Letter of Approval requirements, flexible crediting period definitions (particularly for PoAs), reconsidering the magnitude and timing of registration and issuance fees, simultaneous consideration of new methodologies and the accompanying proposed project, and a standardized approach to demonstrating DOE competencies. The World Bank study on "improving credit issuance through improving monitoring and verification procedures and issuance rules in the CDM," also includes important proposals on improving the CDM that are particularly relevant for energy access programmes. This follows earlier work by the World Bank, in cooperation with a wide range of stakeholders in developing countries, to streamline and simplify the CDM project cycle (World Bank, 2011). Based on these proposals, the ongoing work of the EB, and the interviews with experts conducted as part of this study, there are five important themes of CDM reform that could facilitate the support of energy access RBF programmes:

[21] CDM EB82 Agenda, Annex 12

[22] CDM EB84 Agenda, Annex 1.

5.1 Simplification and expansion of Standardized Baselines

Out of the 29 standardized baseline (SB) proposals submitted as of October 2015, only two have directly addressed energy access – "Electrification of Rural Communities in Ethiopia Using Renewable Energy" and "Cook stoves in Senegal" – and these has been under review since June 2014 and December 2014, respectively. In addition, a proposal on improved stoves for institutional use in Uganda (ASB0016), was approved in October 2015. The complexity of the "Guideline: quality assurance and quality control [QA/QC] of data used in the establishment of standardized baselines"[23], is one deterrent to greater use of the SB framework, because the quality assurance levels specified can be difficult to achieve in many developing countries. The EB has also initiated three top-down SBs in collaboration with Designated National Authorities (DNAs), one of which addresses energy access: forestry in Namibia, Brick making in Peru, and cook stoves in Burundi.[24] The Burundi proposal will be based on two approved methodologies that address cooking with biomass[25]. There is substantial scope to expand and simplify the standardized baselines framework in ways that would benefit energy access programmes, and many of these were highlighted in an earlier World Bank paper (World Bank, 2011). The successful approval of the Uganda cook stove SB is a positive step to address some of these issues, because that documentation explicitly addressed quality of service and minimum service levels, and how to justify an SB even when the data availability is limited. Key recommendations still relevant for energy access programmes are presented in Box 11. These measures would reduce transaction costs for energy access programmes, and reduce the time delays for registration and issuance of CERs. An additional benefit of these improvements to the SB framework would be that these baseline parameters would potentially be used by mechanisms or instruments outside of the CDM as well.

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[23] https://cdm.unfccc.int/Reference/Guidclarif/index.html

[24] Although not strictly SBs, the EB's approval of default values for the fraction of non-renewable biomass and the inclusion of default biomass consumption values in AMS II.G also greatly simplify the use of CDM for cook stove programmes.

[25] AMS-I.E Switch from non-renewable biomass for thermal applications by the user (ver. 05.0) and AMS-II.G Energy efficiency measures in thermal applications for non-renewable biomass (ver. 06.0)

Box 11. Recommendations to improve standardized baselines framework for energy access programmes

Allow the use of more default values: Experience in least developed countries (LDCs) shows data availability is often a problem. It would therefore be useful to propose default values for various common parameters that could be applied globally. Should a country DNA choose to use these default values, these data could be used for all facilities that utilize standardized baselines. The adoption of materiality standards in the application of this guidance would be useful.

Recognize the use of data already available—both nationally and internationally: Considering the difficulties inherent in collecting facility-specific and user-specific data, the guidance document should accept the use of existing data that have been collected for other purposes, for instance, through household surveys. In addition, allow the use of secondary data collected by relevant national institutes or government agencies for various purposes in addition to country-specific data published by the International Energy Agency (IEA), the Food and Agricultural Organization (FAO), etc.

Guidance on minimum service levels: Whenever information on minimum service levels* is not available or varying minimum service levels are reported, a procedure for defining default values for minimum service levels by DNAs and communication to the UNFCCC needs to be specified to avoid variations on the minimum service levels identified by the project developers. Guidelines need to be defined on the procedure for requesting the revision of a minimum service level approved by DNA or EB for situations in which the approved minimum service level is not relevant to the project/program context.

Allow the use of service quality as a criterion: Guidance on how to recognize the quality of service needed and provided would help the developer narrow down the list of relevant technologies/measures and thus reduce the amount of data and data analysis needed. This would also help identify the technologies that are substitutable while eliminating technologies that are too costly.

Source: World Bank (2011)

*minimum service level is a concept used in the guidelines on suppressed demand, and allows for the baseline to reflect the energy services needed to provide for basic human needs, even if these needs were not met historically in the project area. The minimum service level concept is not currently included in the Standardized Baseline guidelines.

5.2 Further simplification and standardisation of MRV

Low cost and predictable monitoring, reporting and verification (MRV) requirements for CDM programmes are essential for delivery of CERs to energy access RBF programmes. The EB has taken important steps over the last two years to simplify the MRV process, including recent decisions to allow for unlimited flexibility in verification schedules for PoAs and increasing the flexibility of post-registration changes. Nevertheless, some additional key steps that would assist energy access programmes in particular include the following:

- **Data collection by technology sectors**: Companies and organizations in some technology sectors (e.g. solar home systems, cook stoves, etc.) have begun to collect data on usage directly from their products via sensors and other monitoring devices. In most cases, however, there is no system for aggregating this data, or for sharing it with other project implementers in that sector and country.

- **Aggregated monitoring**: While baselines and additionality have been increasingly standardized, including in some energy access methodologies, monitoring is still largely project-specific. For example, in a country with four of five different cook stoves PoAs (which is not uncommon), every PoA would be conducting both ex-ante and ex-post surveys among their consumer group to establish certain parameters (e.g. quantity of biomass used with the new cook stove). An alternative could be to establish a national sampling programme[26] that would efficiently serve all of these PoAs at lower cost and with higher accuracy (i.e. from larger total sample sizes). The outputs of these national surveys would be standardized monitoring parameters, similar to standardized baseline parameters in the current SB framework. This would be particularly helpful for technologies with low emissions reductions (e.g. solar lanterns, solar home systems), where monitoring costs can outweigh the payments for CERs.
- **Registration and issuance fees**: As mentioned earlier, the question of CDM registration and issuance fees – both their magnitude and timing – is an outstanding issue that has been raised by stakeholders (UNFCCC, 2015a). The fees for registration and issuance are both $0.10 per CER for the first 15,000 CERs and $0.20 per CER beyond that. The registration fee is waived for projects in least developed countries (LDCs) and projects with expected CERs of less than 15,000 per year over the crediting period. While these amounts are modest in comparison to the CER prices prior to 2012, they are currently on par with secondary CER prices. Any other RBF instrument using the CDM system for MRV would also need to make provision for covering these costs. Whether these costs present a significant barrier to new projects depends entirely on the magnitude of the RBF payments.

5.3 Pre-issuance of CERs

The concept of pre-issuance would be to issue a percentage of the expected first monitoring period CERs at registration instead of waiting until after verification to issue any CERs. The percentage of CERs brought forward by a year (or more) could relate to the historical performance of that technology under the CDM. Assuming that the project owner could immediately market the CERs, the pre-issuance would bring forward the cash flows for the recipient and reduce the time required to start to recoup their investment. It would also reduce the need for access to business capital, since some carbon revenue would be available during (or even before) implementation. After the first verification, the remainder of the CERs for that period could be issued, plus a share of the expected CERs from the following period. If the project consistently delivers the expected level of CERs, the percentage issued in advance could be increased. While this concept is controversial, it is part of a continuum between 100% ex-post payment for results and traditional ODA with almost 100% paid up front. Pre-issuance of a portion of CERs is an extension of the idea of *partial* pre-payment for results, while still providing strong incentives for performance (see section 3.4). This approach is similar to the Uganda GET FiT premium payment system

[26] The programme would, of course, utilise whatever stratification was necessary to account for material differences in the consumer base across PoAs.

described earlier, in that part of the payments are made before all of the performance is complete. To safeguard environmental integrity (i.e. minimise the risk of issuing CERs for mitigation that never occurs), the pre-issuance practice could be restricted to technology areas where the risk that the project will *not* continue to operate as planned is low, or the share of pre-issuance could be reduced to account for increased risk of non-performance in a particular technology area. A share of CERs could also be kept in a "buffer account", similar to what has been discussed for afforestation and reforestation projects, to mitigate the risk that emissions reductions will not be achieved (see, e.g. Gold Standard, 2013). Note that pre-issuance is similar to pre-financing of CER purchases, except that pre-financing is dependent on each buyer's preferences while pre-issuance could apply to projects irrespective of the CER buyer. Because pre-issuance introduced additional risks, however, (since the "result" has not yet been achieved), partial up front financing would be the preferable approach to reducing the project owner's need for capital.

5.4 Project cycle simplifications for automatically additional project types

An important theme within CDM reform in recent years has been to simplify or eliminate the requirements for additionality demonstration and baseline setting for project types that are highly likely to be additional. An example such project types is the positive list in the tool for "Demonstration of additionality of small scale project activities", which lists several technologies (e.g. off-grid technologies such as solar and rooftop wind, hydro and wind below 100 kW units, rural electrification with renewable energy where access rates are below 20%), that are considered automatically additional as long as the total project size is below the small scale CDM thresholds. Because the EB has determined that the risk of non-additional projects in these categories is very low, these project types could also use an optional **standardized registration process or, for CPAs, a standardized inclusion process**, as proposed by the World Bank (Platanova-Oquab et al., 2012). The simplified process could eliminate the detailed validation step by a DOE prior to registration, and substitute a simple checklist for determining eligibility, which the UNFCCC Secretariat would review as part of the standard completeness check.[27] The projects would be registered on this basis, and all of the project characteristics and performance would be confirmed by a DOE during the first verification. Because no CERs would be issued until after first verification, such a change would not compromise the environmental integrity of the CDM. It would, however, dramatically reduce the transactions costs and time required to get to registration (e.g. 6 months instead of 2 years or more) – so that projects could start generating CERs earlier. The early registration also reduces uncertainty for investors and RBF funders, and could increase the total revenue that projects can earn.[28] This streamlined procedure could apply to both projects that already qualify for automatic additionality, as well as the inclusion of CPAs comprising technologies that qualify for the same. The registration of the overall PoA would

[27] Note that EB86 agreed to further explore the conditions under which DOEs would be exempt from an on-site validation requirement, opening the door to more flexibility in the project cycle.

[28] For an improved cook stove with a life of 8 years for example, under the current system a delay of 2 years to reach registration, which implementation may have already started, could mean the loss of a quarter of the lifetime carbon revenue.

remain the same, with a full validation by a DOE. Safeguarding the environmental integrity of the CDM would require regularly reviewing the automatic additionality provisions that would allow certain project types and locations to access this simplified process.

Part of streamlining the registration process for certain project types would also include **revisiting the definition of "micro-scale" thresholds**, which are used to define one of the groups of technologies eligible for automatic additionality. Currently project activities or CPAs below a specific size[29] are classified as "micro-scale" and are considered automatically additional in LDCs, Small Island Developing States (SIDS) or special under-developed zones designate by DNAs. In addition, other criteria may allow automatically additionality for this size of project, including designation of the technologies by the DNA, technologies that serve off-grid communities, or technologies that have very small independent units (e.g. less than 600 MWh per year savings per unit or 600 tCO_2 emissions reductions). The streamlined treatment for this scale of project means that project developers often size CPAs to be just under the microscale limit, so that an entire PoA (of unlimited total size) can qualify as micro-scale. The additionality of many energy access technologies (and the barriers that they face), however, is largely related to their unit size rather than the total number of units. An alternative approach, then, would be to use only unit thresholds to determine the applicability of micro-sale rules. For example, a solar lantern programme would be micro-scale no matter what the total number of units distributed through the PoA was, because of the small unit size. This category would then be eligible to use the streamlined registration or inclusion process, regardless of the total scale. The recent decision by the EB (EB86) to approve revised micro-scale definitions and allow the use of unit size as the determining factor is a positive step in resolving this issue (UNFCCC, 2015b).

5.5 Aggregated or Sectoral crediting

As an extension to the idea of aggregated monitoring, a broader issue for CDM RBF is whether the scope of CDM can be **expanded to address sectoral programmes and crediting** and, more importantly, quantify impacts at a sectoral level without facility-level measurement. Already with PoAs, a single CDM programme could, in principle, address the entire electrification programme of a country and could even support distribution of improved cook stoves to an entire rural population. CDM does not include the impact of policies, however, and the current rules always require some form of "bottom up" monitoring process, even if sampling is used. The concept of crediting at the sectoral level would be to reduce transaction costs by measuring performance at a higher level, to cover the impact of a wide variety of projects, programmes, and policies. For energy access, this could be similar to a results-based programme with a host country government, who would receive incentives for achieving certain results in terms of access targets (e.g. access to electricity and clean cooking fuels). The host country would have the autonomy to use a wide range of policies and programmes to further incentivise various actors in the sector to achieve these goals. As discussed earlier, for a results-based programme to be successful, the agent (in this case the

[29] 5 MW for renewable energy, 20 GWh per year savings for energy efficiency, and 20,000 tCO_2 emissions reductions for other project types.

host country government) must have reasonable control over the result and the result must be straightforward to measure. Governments do exert a strong influence over energy access, given not only the importance of policies but also the role of government in channelling funding into the sector. In terms of identifying the right "result" for access, there are a number of considerations:

- The absolute number of households with access (electricity or clean cooking) is a better measure than the access rate (i.e. percentage of households), since the latter is influenced by population growth, household size and migration (i.e. if rural and urban access are tracked separately)
- The two fundamental options for monitoring are to count all of the households having access individually or to survey a sample of households periodically to estimate the total number with access. For grid electricity or even mini-grids served by utilities, counting them all is not necessarily difficult or costly if utilities or other service providers have comprehensive customer lists and billing records. This is not true, however, for off-grid power kits sold through distributors, nor is it true for most clean cooking options (except those with a fuel supplier), so some form of sample survey would be necessary. An advantage of the survey is that it may be possible to also measure the quality of service and not just a binary "access/no access" (see chapter 4.1 for comments on tiers of service).
- An additional consideration is the baseline for this access metric, and whether the access levels at the start of the programme should be used or a more "forward looking" baseline. Using current levels would implicitly assume that access levels will not increase at all without carbon finance, which may not be realistic in all settings. The CDM rules acknowledge this by allowing for automatic additionality for renewable energy rural electrification projects where the access rates are less than 20%. For other conditions, an increasing access baseline might be necessary.

Even though one "result" would be access levels, CDM RBF schemes also need quantification of GHG emissions reductions. As a second step, therefore, the access results need to be converted to emissions reductions. Taking electricity as an example, an option for this might be to establish weighted average baseline emissions based on the mix of consumer types and previous sources (e.g. based on a national survey) and weighted average project emissions based on the mix of sources of new supply (e.g. share with grid times emission factor for grid, share with mini-grid times emission factor for typical mini-grid, etc.). For clean cooking, options include a pre-implementation survey for baseline fuel consumption, a survey instrument after the programme started, or default baseline consumption levels as allowed in AMS II.G. There would also need to be some adjustment to factor in the range of technologies used to provide clean cooking services, since technologies vary in their efficiency. Developing this aggregated project indicator would also allow the programme to be more "technology neutral", in the sense that a wide variety of technologies could be used to achieve the access goals but their characteristics would still be addressed by the emission reduction calculations.

A further extension of the concept of crediting for an entire sector would be to directly link policy changes – the type of actions necessary to create the right "enabling environment" for energy access programmes as discussed in chapter 2.4 – to crediting for emission reductions. Such an approach was proposed early on in the life of the CDM, in the Ghana Air Conditioner programme to implement mandatory minimum energy efficiency standard within one year (Niederberger, 2007; Sathaye, 2007). This proposal would have allowed Ghana to receive CERs for a suite of activities including developing a testing facility, enforcing technical standards, raising retailer and consumer awareness, and capacity building, all to increase the energy efficiency of air conditioners. The EB's response to this and similar proposals was to clarify that the policies and regulatory actions did not qualify under the CDM modalities and procedures, so this would require significant reform of the CDM rules.

5.6 Additional issues

Many of the requirements in the CDM that impact project development risks, and therefore the reliability of CDM RBF triggers for payment, are specific to particular baseline and monitoring methodologies. The first approved methodology for energy efficient lighting for example, has only been used twice in the last eight years because of the complexity of the monitoring requirements. Energy access methodologies have received considerable attention in the last several years. For electrification, new small scale methodologies were approved that recognised "suppressed demand" for energy services and so provided more CERs to these project types.[30] The methodology most commonly used for improved cook stoves[31] was revised significantly, has been widely used for both projects and PoAs, and is currently undergoing another round of public input and revision[32]. However, there is ample scope to **further simplify the energy access methodologies**. A recently approved methodology sponsored by Ci-Dev, for example, will simplify the procedures for electrification programmes[33]. The new methodology covers all types of electrification (i.e. household-scale, mini-grids and grid extension) and is designed to fit the energy access business models discussed earlier in this paper.

Using the **CDM system as an MRV tool for other RBF instruments** would build on the years of development and experience with quantification of GHG reductions, and the broader quality assurance and quality control (QA/QC) system necessary to make that credible. This could happen even if the CERs were not used for compliance with Annex I country commitments under a new climate agreement. The CER could simply be used as evidence of the activity, which is directly related to the energy access impacts as well, because the calculations of emissions reductions are directly related to measured energy consumption values. This could be combined with revising the methodologies to explicitly report other energy access-related triggers. For example, for an electrification project, the methodology and verification process could include the measurement of the usability of the energy

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[30] AMS I.L Electrification of rural communities using renewable energy --- Version 3.0 and AMS III.BB Electrification of communities through grid extension or construction of new mini-grids --- Version 2.0

[31] AMS II.G "Energy efficiency measures in thermal applications of non-renewable biomass --- Version 6.0"

[32] https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150512122719495/A02_Questions_AMS-II.G.pdf

[33] http://cdm.unfccc.int/methodologies/DB/XJQ7APPRHQWLO6VSC3161I5Q8MCMNQ

services, or could even include the calculation of the energy service tier. Including all of the relevant triggers in one MRV process, although it would add to the CDM methodology, would make the overall MRV process for the RBF instruments more transparent and cost-effective.

One cautionary note on the relationship between CDM and other climate finance mechanisms is the need to ensure that new instruments do not result in “stranded” CDM activities. Given that the new climate finance market mechanisms (both RBF approaches and otherwise) are at a very early stage of development, this could happen if there is not a clear decision to recognise PoAs under development and allow them to continue to receive CERs, if the project proponents choose this route for registration, so that they are not prejudiced by new funding modalities.

The table below summarises the main CDM reforms presented, and how they can impact the elements of successful energy access CDM RBF programmes.

Table 7. Impact of CDM reforms on elements of success for energy access RBF programmes

Action	Cost structure and cash flows			Access to business capital	
	Reduce transaction costs	Reduce risk	Reduce time required	Increase revenue	Reduce capital need
Standardized baselines					
Allow more default values	✓	✓	✓		
Recognize data already available	✓		✓		
Guidance on minimum service level	✓			✓?	
Service quality as a criterion				✓	
Simplification of MRV					
Data collection by technology sectors	✓		✓		
Aggregated monitoring	✓				
Revise registration and issuance fees	✓				
Pre-issuance of CERs		✓	✓	✓	✓
Project cycle simplification					
Standardized registration/inclusion	✓		✓		
Revised micro-scale thresholds	✓			✓	
Sectoral or aggregated crediting	✓			✓	

6. Conclusions and recommendations

This chapter presents conclusions and important recommendations for promoting energy access through CDM RBF schemes. The recommendations are grouped into four areas: design priorities within a CDM RBF scheme, packaging RBF schemes with other financial instruments, reform within the existing CDM framework, and moving beyond the current CDM framework. In each section, the implications for CDM RBF funders are also discussed.

6.1 CDM RBF design priorities

The analysis of how CDM RBF instruments could provide effective performance incentives for energy access programmes highlights important design priorities:

- **Consider funder and recipient capacities as eligibility criteria**: regardless of the technology and project type supported, funders need the institutional and fiscal stability to offer credible, long-term funding streams, including the ability to withhold payments from programmes that do not deliver. Revolving funds are therefore one promising way to manage these funding streams, so they are not affected by short term budgetary issues. Recipients must have sufficient institutional capacity to respond to the incentive scheme, as well as the domestic financial capacity to bridge the gap between investments and receipt of RBF payments. Indicators such as the World Bank's *Doing Business* survey could assist with the latter, while studies on national institutional capacity could assist with the first criteria (ESMAP, 2015a). Providing performance incentives in markets without a conducive enabling environment in place should be avoided. RBF funders could therefore develop a country and sector screening process to target activities where the enabling environment was not a barrier to success.
- **Establish partnerships with local financial institutions, equipment suppliers, and other intermediaries**: These actors are critical to the success of a CDM RBF scheme and would ideally be involved in the design process for the instruments applied in that country and sector. RBF funders could proactively seek out these actors in the markets that host the current pipeline of PoAs, to look for opportunities to support linkages and partnerships.
- **Provide flexibility in payments**: for activities with lower risk of non-performance, more of the payments could be shifted earlier in the project life. This could accelerate the energy access investments while still maintaining operational incentives. RBF funders could consider whether a modest share of the value of the carbon revenue could be paid early in the project cycle (e.g. registration), following the earlier example of World Bank carbon funds.
- **Expand triggers to non-GHG outcomes and intermediate impact results:** even if CER generation is the primary condition for payment, energy access support schemes should always have payment conditions that reflect the desired objectives of the programme, which are typically the usability of the energy supply, consumption of energy services, and higher-level development benefits. These indicators should also be built into the CDM RBF scheme. RBF funders could pilot using these metrics with their existing

pipeline, as well as different options for payment (e.g. requiring both metrics to be met before full payment is made, or paying part of the incentive for each metric separately).

- **Match baselines for non-GHG metrics to CDM baselines**: for project types that are considered automatically additional in terms of GHG emissions reductions, using the current situation for the energy access baseline is appropriate. But for project types that may have a dynamic or forward looking baseline in the CDM methodology (e.g. grid extension projects), similar consideration should be given to estimating future access levels that correspond to any changes in future emissions in the baseline. RBF funders could pilot these activities to test the practicality of such an approach, and also assess the level of donor concern about this issue.
- **Use auctions where possible for price discovery and efficiency**: the practical and conceptual challenges of administrative pricing mean that auctions are preferable as long as there are sufficient actors in the sector that can respond, and the funder or host country has the capacity to administer the auction. RBF funders could pilot such an approach in specific markets where there is a conducive enabling environment and significant number of actors with experience in energy access business development, holding an auction for both CER delivery and, potentially, other energy access results. This could also test whether using auctions for greenfield projects significantly increases the prices required. This could be done in partnership with the public agencies that oversee the relevant sectors and technology areas.
- **When using administrative pricing, develop consistent approaches for estimating component costs**: While some technologies such as improved cook stoves could be supported through CER-linked capital subsidies, for many solar technologies these payments may only be able to cover components of the overall programme. Identifying components that are catalytic for the sustainability of access programmes, such as maintenance and parts replacement, and developing consistent approaches to costing these components would open more opportunity for carbon financing to support energy access.
- **Work toward including payments for non-climate benefits and/or links to markets for these benefits**: In cases where administrative pricing is more feasible than auctions, a valuation of other benefits such as health, local environment and economic development should be considered in setting the prices. Even in auctions, the funder could provide additional top-up payments for successful bidders based on specific non-GHG benefits. In both cases, the valuation could be linked to emerging markets for these sustainable development impacts.

Most of these recommendations are relatively low risk, although they may require additional research to put into practice (see chapter 6.5). Payment flexibility should be carefully managed, to balance the cash flow needs of the project developer with the funder's desire to ensure performance. The benefit of this flexibility, however, could come in catalysing much larger implementation of energy access projects that face upfront financial barriers. Similarly, as discussed earlier, auctions require deliberate design to reduce the risks of underbidding by participants and subsequent underperformance, as well as to ensure there are sufficient participants to foster healthy competition and price efficiency and to keep the transaction costs down for both the funder and bidders. The potential benefit from taking this risk is much greater efficiency in the use of public funds to incentivise mitigation.

6.2 Combining CDM RBF schemes and other instruments

- **Package complementary instruments for supporting energy access:** To exploit the synergies between CDM RBF approaches, RBF outside of climate finance, and more traditional financing for energy access, and to address many of the upfront needs for energy access programmes, funders should consider packaging any CDM RBF instrument with a set of complementary instruments that would address the relevant gaps in that particular country and market. Following the earlier discussion of the need for business capital, funders could use equity fund investments to reduce risk and leverage private finance. The overall equity fund would have a diverse portfolio of companies in which it invests for scaling up market action. These funds might also cover many countries and markets to diversify risk. Risk guarantees could similarly be applied across a wide range of markets where parallel RBF interventions were planned. For the capacity development to receive, manage, and participate in CDM RBF programmes, a more tailored approach may be needed to suit the needs of each country. This capacity development must precede the launch of a scheme such as an auction, so that the potential agents can participate fully. Finally, non-RBF grants may be useful for early stage innovation and technology development. CDM RBF funders could explore how to create or partner with equity investment funds that could provide project financing for their energy access pipeline, as well as capacity building programmes that would support national governments in creating enabling environments for the scaling-up of energy access businesses.
- **Maintain existing CDM RBF support even as new climate finance mechanisms are expanded**: For example, programmes developed under the CDM should still have the ability to generate and market CERs even if other RBF schemes (or non-RBF support programmes) are initiated. Providing this option for existing programmes will enhance the credibility of all RBF instruments and reduce the risk for investors.

6.3 Reform within the existing CDM framework

- **Expand and simplify SBs**: Allowing the use of more default values and recognising data that is already available for the sector would reduce the transaction costs and time required for delivering CERs, as well as reducing risk. Incorporating guidance on minimum service levels in the SB rules and include service quality[34] as a criterion when evaluating alternative technologies in the SB justification process would also reduce costs and could also increase carbon revenues.
- **Further simplify energy access methodologies**: as discussed earlier, more can be done to increase the use of properly-justified default factors and tie monitoring to rigorous aggregated measurements. Recent proposals for methodology development are already

[34] The standardized baseline for brick manufacturing in Peru currently under development provides an example of this. See TSB0002 at https://cdm.unfccc.int/methodologies/standard_base/new/sb9_index.html

addressing many of these issues, although increased use of sampling across all methodologies could also be proposed.

- **Simplify the CDM MRV process**: data collection at a sectoral level, and aggregated monitoring at a higher level than each PoA, could reduce transaction costs and actually increase accuracy. Revising the magnitude and timing of registration and issuance fees could also improve cash flows for energy access programmes, particularly in current depressed carbon market.
- **Explore pre-issuance of CERs for low risk project activities**: for energy access technologies with lower risks of non-performance, a share of expected first year CERs could be issued at registration, and then reconciled with actual performance each year. CDM RBF funders could not only propose this to the EB, but could simulate it in their payment structures, essentially paying in advance for part of the next year's CERs, starting at registration. Pre-issuance would be, in essence, similar to pre-financing CERs sales, so funders might prefer to this entirely though financing and maintain the requirement that every CER must represent a results that has already been achieved.
- **Simplify the CDM project cycle**: using a checklist list approach for registration of activities that are deemed automatically additional, as well as inclusion of CPAs from the same project types, would have a major impact on reducing transaction costs and time delays for energy access projects.
- **Expand CDM methodologies to serve broader RBF programmes**: indicators of outcomes and intermediate impacts for energy access programmes should be included in the CDM methodologies, so that the CDM system can provide a comprehensive set of MRV tools for RBF programmes targeting energy access. RBF funders could propose revisions to the energy access methodologies that would incorporate these additional indicators.

CDM reforms must always carefully mange the risks of negatively impacting environmental integrity while trying to reduce transaction costs and project cycle delays, particularly changes that reduce the level of project review or provide faster access to CERs. Managing these risks requires limiting simplified procedures or requirements to those technologies where wide-spread barriers can be demonstrated (e.g. the energy access technologies covered in this study) and ensuring that any default values used are suitably conservative. The potential benefit of these changes, however, is unlocking the potential of climate finance for energy access and dramatically upscaling both the mitigation and sustainable development impacts of this sector.

6.4 Moving beyond the CDM

Explore how CDM methodological approaches can be broadened to sectoral crediting: to broaden the scope of the CDM to a sectoral level, new methodological approaches are needed. The practical challenges will be establishing a baseline for the consumption levels at an aggregate level and finding a way to capture the diversity of household access levels and previous energy use patterns in a highly aggregated measure of access. Even though this is not currently possible under the CDM rules, RBF funders could propose such approaches using their own pipeline of projects as case studies of the options for setting these more aggregated baselines and emission reduction calculations. These approaches would either need to maintain the same level of rigor demanded by project and programme-based CDM, or, alternatively, form part of a modified or new crediting mechanism.

- **Develop and link other markets for environment and social benefits**: the CDM RBF community should support the emerging efforts to quantify non-GHG benefits of energy access programmes, and development of markets for these. The examples provided in this paper on time savings are a starting point, but there could also be markets directly related to energy access indicators.
- **Explore synergies with the new climate finance providers on energy access**: while new institutions such as the GCF are in the midst of elaborating their investment and results management frameworks, this is the time to demonstrate how the CDM system could provide the basis for MRV for energy access programmes. CDM RBF funders could demonstrate this with practical examples from their energy access pipeline, as well as through proposed revisions to the CDM methodologies that would allow them to measure a more comprehensive set of results.

Expanding to a broader level of crediting and a wider side of benefits does create potential risks, because the climate finance community has less experience assessing the environmental integrity implications of sectoral baselines and crediting, and the tools to minimise these risks. This is both an important research issue but also an area where some “piloting” experience may be necessary to understand the implications. Just as it took years to accumulate enough practical experience in project-based carbon markets for the international community to learn how best to balance keeping transaction costs low with ensuring environmental integrity, this will be the case for more aggregated crediting as well.

6.5 Areas for further research

Many of the recommendations provided here could also be supported by further research, including using pilot activities. This is particularly true of the recommendations on structuring an RBF instrument and those on moving beyond the current CDM scope.

On CDM RBF design, quantifying the component costs of a variety of energy access projects using a larger sample of case studies, as well as ex-post assessments of barrier removal projects, could provide a stronger justification for how using RBF to address these costs could catalyse more successful and larger energy access initiatives even when they do not cover the full incremental costs. To reward non-climate benefits under an RBF scheme, research is need not only on what tools and methodologies may be available to quantify these benefits for energy access projects, but also on the options for how payments should incorporate these additional results (e.g. separate payments for different results, triggers that combine multiple results, payments based on changes in service tier levels). In addition, research on the use of auctions in other sectors (e.g. renewable energy development) could shed light on how and whether to use auctions for greenfield projects under an RBF scheme.

In terms of moving beyond the current scope of CDM to more aggregated approaches, while there is some literature on the concept of sectoral crediting, there are almost no concrete examples on how this could be applied in a specific sector, and particularly how the sectoral results could provide incentives for the individual actors within the sector. Because the mechanisms for this could vary according to the structure of the sector or technology area, an energy access-specific analysis of options for sectoral crediting would be valuable. The same is true of utilising other markets (e.g. for social and environmental goods) to monetise the benefits from energy access programmes. This should explored for specific energy access technologies and the sustainable development impacts they deliver, to ask whether it is possible to support the further development of market-based approaches to reward these benefits in the context of RBF schemes. Finally, the imminent development of broader climate financing channels and institutions such as the GCF provides a unique opportunity to shape the methodologies and approaches used to quantify benefits and disburse funding, so that energy access programmes can be dramatically scaled up. More detailed analysis of not only what RBF methodologies and tools could be applied by these institutions, but also how those tools could be adapted to promote energy access programmes, would have the most influence if presented during this formative stage for future climate finance mechanisms.

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Annex A: Experts interviewed

Name	Organisation
Ingo Puhl	South Pole Group
Oliver James Knight	ESMAP/World Bank
John Ward	Vivid Economics
Pepukaye Bardouille	IFC
Mark Davis	Norfund
Ash Sharma	NEFCO
Zubair Sadeque	World Bank (Asia)
Matthew King	Ci-DEV/World Bank
Daniel Radack	Ci-DEV/World Bank
Stephan Hoch	Perspectives Climate Change
Bill Farmer	Uganda Carbon Bureau
Glory Edozien	EnviroAfrica
Sandra Greiner	Climate Focus
Ousmane Fall Sarr	Senegal Rural Electrification Agency
Pacifica Achieng	KenGen, Kenya
Glenn Hodes	UNDP Asia Pacific