WORLD BANK GROUP
Climate Change

Ci-Dev
CARBON INITIATIVE FOR DEVELOPMENT

A NEW APPROACH FOR PRE-FINANCING EMISSION REDUCTION PURCHASE AGREEMENTS FOR HOUSEHOLD ENERGY ACCESS PROGRAMS

www.ci-dev.org

This report was prepared by Torsten Becker, Michael Eschmann, Silvia Kreibiehl and Ulf Moslener at the Frankfurt School – UNEP Collaborating Centre for Climate and Sustainable Energy Finance under the guidance of a World Bank Ci-Dev team led by Klaus Oppermann and including Felicity Spors, Kirtan Sahoo and Caroline Ott

October 2016

Table of Contents

List of Abbreviations

CAPEX	Capital Expenditure
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
Ci-Dev	Carbon Initiative for Development
CME	Coordinating Management Entity
CPA	CDM Program Activity
CSR	Corporate Social Responsibility
DD	Due Diligence
DOE	Designated Operational Entity (of the CDM)
DTU	Danish Technical University (former UNEP Risoe Centre)
EB	Executive Board (of the CDM)
ERPA	Emission Reduction Purchase Agreement
GHG	Green House Gas
IFI	International Financial Institution
IGES	Institute for Global Environmental Strategies
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau (German Development Bank)
LDCs	Least Developed Countries
LPG	Liquefied Petroleum Gas
MFI	Microfinance Institution
MIGA	Multilateral Investment Guarantee Agency
MRV	Monitoring, Reporting and Verification
MW	Mega Watt
NGO	Non-Government Organization
NPV	Net Present Value
ODA	Official Development Assistance
PDD	Project Design Document (of the CDM)
PE	Private Equity
PIN	Project Idea/Identification Note (for an ERPA)
PoA	Program of Activities
PPP	Public-Private Partnership
RE	Renewable Energy
RBCF	Results-Based Climate Finance
SHPP	Small Hydro Power Plant
SPV	Special-Purpose Vehicle
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

The World Bank's Carbon Initiative for Development (Ci-Dev) supports low-carbon household energy access programs through results-based payments for Certified Emission Reductions (CERs). However, many potential Ci-Dev projects cannot be realized in the first place due to initial financing constraints. While CERs are often the main funding source over the lifetime of a program, they are only paid after results have been verified by the United Nations Framework Convention on Climate Change (UNFCCC). Therefore the pre-financing of CER revenues can contribute to the unlocking of a substantial project volume.

In the past, the pre-financing of CER revenues was considered for supporting larger renewable energy (RE) generation projects. However, the financial viability of such projects hardly depends on CER revenues, of which the share in the overall project revenue stream is often insignificant. On the other hand, this study finds that CER pre-finance is highly relevant for household energy access programs for which CER payments are usually the main (if not the only) revenue stream. Household energy access programs aim to make low-carbon energy technologies accessible and affordable. Especially programs implemented by non-governmental organizations (NGOs) and public-private partnerships (PPPs) offer energy systems at low/no cost, and hardly generate any sales revenues.

The main risk of pre-financing CERs is the actual CER delivery, which in turn depends on project performance, local market conditions, CDM regulation and country-specific (political) matters. Performance risk and market risk can be quite significant for energy access programs, whereas the regulatory risk of CDM registration and CER issuance is moderate to low. In the context of Ci-Dev, political risks can be relatively high as the fund primarily targets least developed countries (LDCs); yet there are no counterparty (off-take) and CER price risks.

Ci-Dev issues Emission Reduction Purchase Agreements (ERPAs) until end of 2024. However, CERs should not be pre-financed over the entire ERPA duration. Pre-financing should rather be done in tranches. Short-term contracts, for example over the lifetime of the low-carbon energy systems, facilitate the alignment of pre-finance volumes to predictable CER targets. Besides mitigating risk, this gradual contracting structure would also result in significantly lower required pre-finance funding volume.

The pre-financing of CERs for household energy access programs is a new feature of results-based climate finance (RBCF) that will require a pilot phase before being scaled up and perhaps commercialized. It is usually the public sector that demonstrates the feasibility of a new financing approach. A demonstration project should not be overly complex, particularly in the context of CDM in which the registration and verification process has often been criticized as lengthy and bureaucratic.

For pilot-testing CER pre-finance in the context of Ci-Dev, it appears advisable to set up a donor-funded reimbursable grant facility. This facility could disburse grants to individual programs for closing the (CER-related) pre-finance gap of a certain period. The programs would then reimburse the grants after selling results-based CERs to Ci-Dev. The facility could be initiated in a short lead time, could quickly create a track record at a relatively low cost, and could have a revolving character unless there are substantial default rates.

If the pre-finance approach is successfully demonstrated – that is by a high reimbursement rate – the facility can be scaled up by developing new programs and by expanding or duplicating programs in the Ci-Dev (and overall CDM) portfolio. This scaling-up process is typically achieved by attracting private investors for leveraging public money, and by transforming or integrating the facility into another instrument.

The selection of the new instrument will depend on the expected pre-finance volume (justifying transaction costs) and on the willingness and ability of the World Bank to provide interim pre-finance and risk buffers. Assuming that at least one of the requirements is not fulfilled, it is likely that the World Bank might opt for a new layered fund. Other conceivable instruments are green bonds, securitization, or operating through another existing finance facility.

A reimbursable grant facility is typically funded by national governments (taking the first-loss in case of under-delivery of CERs) and International Financial Institutions. Perhaps donor funds can be leveraged by money from foundations that are committed to fighting climate change and/or promoting clean energy access. The grant facility as such could also form the basis for the layered fund. In climate and development finance, layered funds often feature an asymmetric risk-return allocation between junior and senior tranches. Private investors – most likely those who also measure their performance in terms of positive social and environmental impact – would be offered the highest return for the least risk. As the private sector gains experience and the viability of the projects is demonstrated, it would be expected that the donors' contribution could be reduced until it was no longer needed.

1. Introduction

The World Bank Carbon Finance Unit is very active in exploring ways for results-based climate finance (RBCF) to deliver transformative low-carbon and climate resilient development. In the context of its Ci-Dev methodology work program 2016, it has, amongst other things, commissioned three studies that focus on different aspects of how the transition to new types of finance could be aligned with outcomes of the COP21 in Paris.

Ci-Dev, one of the World Bank's six "next generation" carbon initiatives[1], supports low-carbon energy access projects in least developed countries (LDCs). Through results-based Emission Reduction Purchase Agreements (ERPAs) it guarantees the offtake of Certified Emission Reductions (CERs) delivered under Clean Development Mechanism (CDM)[2] projects and programs.[3] The (fixed) CER price of each ERPA is determined on a case-by-case basis, reflecting the individual needs of each project to close the financial viability gap.

[1] The other five instruments are the Carbon Partnership Facility, the Forest Carbon Partnership Facility, the Partnership for Market Readiness, The BioCarbon Fund Tranche 3 (Initiative for Sustainable Forest Landscapes), and the Pilot Auction Facility.

[2] Besides the CDM, Ci-Dev might also purchase emission reductions registered under other standards under the United Nations Framework Convention on Climate Change (UNFCCC).

[3] In the following, the term "project" is used synonymously for stand-alone projects and programs of activities (PoA), unless the distinction between project and program is relevant in the respective context.

Box 1: Carbon Initiative for Development (Ci-Dev)

Ci-Dev supports low-carbon energy access projects in low income countries – projects which are still significantly underrepresented in the overall CDM pipeline. It focusses primarily on household energy access programs in Africa – that is small-scale renewable energy (RE) programs that i) create new connections or off-grid energy access solutions (such as micro hydro, solar home systems, clean efficient cook-stoves, and domestic biogas), ii) bundle small-scale activities, and can be scaled up in the future.[4] Supported projects should come along with other development benefits (financial savings and/or improved welfare at household and/or community level), and should be sustainable (political support, local ownership, private sector involvement) and replicable (national, regional, and possibly international).[5]

For each individual project, following the CDM additionality approach, Ci-Dev assesses the financial viability gap as an estimate of carbon finance required to reach the proposed scale. For private-sector-led projects, financial viability is assessed by means of the internal rate of return (IRR); for public-private partnerships (PPPs) and projects led by non-governmental organizations (NGOs), financial viability is assessed by means of an overall funding gap.

Key stakeholders for all projects can be classified in five categories:[6]

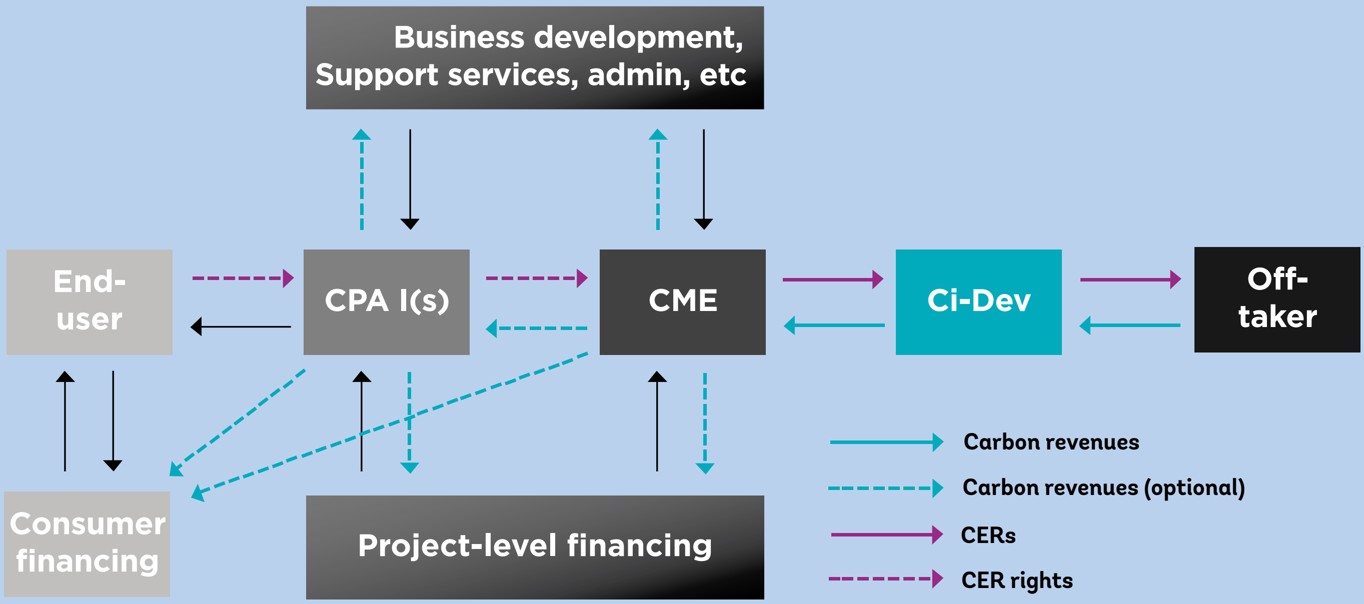
- Final CER off-takers, that is mainly donors and official development assistance (ODA), supporting Ci-Dev for political and strategic reasons like maintaining CDM and mainstreaming RBCF;
- Ci-Dev itself; World Bank is trustee of the carbon fund; World Bank and Ci-Dev (strong sovereign risk rating) are ERPA counterpart and intermediate CER off-taker, respectively;
- The Coordinating Management Entity (CME) that usually signs the ERPA with Ci-Dev;
- CDM Program Activity (CPA) Implementer(s); the CME might be identical to (or one of several) CPA implementer(s);
- End-users of carbon saving technologies, for instance households, communities, other institutions.

[4] The second eligible project category is "innovative" projects that provide transformational benefits in other underrepresented sectors like energy efficiency and waste management/treatment.

[5] See Criteria for Ci-Dev Project Selection and Background and Guidance for Project Idea Submission; http://www.ci-dev.org/node/8

[6] In addition, other stakeholders could be intermediary funds (like a revolving fund for carbon revenues from CME to CPA Implementers) or service providers (like biogas reactor maintenance companies).

Figure 1: Simplified and generalized stakeholder chart (focusing on flows of CERs and carbon revenues):



There are three business models that define for each case whether i) CME, ii) CPA Implementer(s), or iii) both ("hybrid") are responsible for:[7]

- Financing on the project-level (equity, debt, grants, subsidies, working capital, risk sharing, guarantees) and the consumer-level (subsidies/rebate on products, microfinance, leasing, deferred payments); both are currently used, amongst other things, for pre-finance to close the initial financing gap;
- Other business development, compliance, administration and support activities, including: Availability, reliability and affordability of technology/product; consumer mobilization, sales and marketing; delivery and distribution, after-sales, maintenance, warranty, monitoring and evaluation, warehousing and logistics; compliance with policies and regulations; CDM program administration.

[7] Not each of the following categories and sub-categories are applicable in every project.

However, many potential CDM projects (and RBCF projects in general) cannot be realized due to financing constraints. In theory, in order to reach an investment decision, it does not matter when a project will generate (positive) cash flows. The discounted value of expected revenues over the entire project lifetime must exceed the initial capital expenditure and discounted operating costs. Yet, in practice, capital is required for the initial set-up before revenues come in. Banks are rarely willing to lend at this supposedly risky stage unless there is a sufficient equity contribution. There is the possibility that banks would accept the pre-finance of CER revenues as an equity-like contribution as long as their own loan remains senior for debt service. In other words, pre-financing CER revenues could help make a CDM project bankable in the first place.

By definition, due to their results-based character, carbon credits are not designed to directly address initial capital investment needs. A World Bank report[8] found that compliance purchasers, the vast majority of CER off-takers, are either unprepared or unwilling to assume the project risk (that is the operational risk that CERs will be delivered as projected). Hence, they either have not provided advanced payments, or provided only limited advance payments, typically a maximum 25 percent of the ERPA value.[9] Advance payments often require guarantees which are relatively expensive and, for project developers, difficult to obtain.[10] It was found that the bankability of CDM projects (that is the chance for debt funding) increases significantly if an equity contribution of 15 to 20 percent is provided.

Apparently this also applies to Ci-Dev: The World Bank identified that many of the more than 200 submitted pre-Project Idea Notes (pre-PINs) had quite significant pre-finance requirements. Given Ci-Dev's results-based finance structure, only those projects without (or with limited) pre-finance needs could be supported. A pre-finance instrument has the potential to contribute to the unlocking of a substantial larger project volume (see Box 2 for further explanation of how pre-financing can unlock greater project volume).

[8] World Bank, Ci-Dev, 2015: Integrating carbon finance in traditional financing – Key barriers and existing experiences.

[9] The same threshold was found for World Bank itself when – as trustee of different carbon funds – providing up-front financial support to project developers for either capital expenditure or carbon asset creation.

[10] Through guarantees, the ERPA counterparty would reallocate the CER delivery risk to another party.

Box 2: The pre-financing challenge in RBCF programs

RBCF programs provide payments for pre-defined climate results. These payments incentivize the underlying activities that generate adaptation or mitigation results. In most cases undertaking RBCF activities require upfront investments. The delivery of clean electricity for example, typically requires upfront investments in renewable energy installations. Ideally lenders and/or equity investors would "pre-finance" RBCF payments, i.e., would provide the necessary upfront financing based on the expected future revenues. In reality however this is rarely the case as lenders/investors lack experience with concrete RBCF programs. Only over time can RBCF programs provide proof of concept and generate evidence (a pipeline of investments incentivized and climate results delivered) that enable a risk assessment by private finance providers at reasonable cost. Proof of concept provides investors with the confidence regarding both the effectiveness of a public incentive program and the robustness of its underlying politics. Therefore, addressing the challenge of pre-financing of RBCF payments is key for successfully implementing and scaling up RBCF programs. A failure to address this challenge could result in the underperformance of RBCF programs and/or unnecessarily high risk premiums which would results in less efficient deployment of public money.

In a carbon market context, a failure to address the pre-financing needs of carbon payments can also jeopardize the environmental integrity of the carbon market mechanism itself. From its inception the Clean Development Mechanism (CDM) suffered from being unable to mobilize investment financing, despite the fact that the underlying activities could reasonably predict future expected carbon revenues. As a consequence the market became biased towards activities for which the potential contribution of carbon revenues to investment finance was non-critical. Such activities can still be additional in the sense that the carbon revenues secured under the CDM improve the profitability of the underlying mitigation activities to a point where it is possible for the investors to agree to invest. However since the CDM did not contribute to upfront finance the full potential of the mechanism was not ever achieved since the financial contribution carbon revenues can make was too small to trigger broader investment. Since this problem was recognized by the administrators of the CDM, the rules on additionality became increasingly complicated, in order to clarify if the carbon revenues had triggered an investment decision, which in turn aggravated the problem further.

If RBCF is expected to play a larger role in climate finance and if the shortcomings of the Kyoto carbon market and its market mechanisms are not to be repeated in a new future international carbon market, the issue of pre-financing climate payments by private lenders and investors needs to be addressed. Appropriately designed pilot facilities are needed to catalyze the required learning both on the private and public side to ensure that RBCF achieves its full potential.

Section 2 of this study first discusses the particularities of household energy access programs in terms of CER pre-finance. It elaborates on the challenges of financing energy access technologies on household and program level, and presents a typical cost structure of a CDM Program of Activity (PoA). The high relevance of CER revenues and CER pre-finance for Ci-Dev-like projects is highlighted by comparing two exemplary household-level PoAs with two exemplary grid-connected projects.

The two household energy access programs are simulated for the co-financing of i) program costs, based mainly on the West Africa Biodigestor PoA; and ii) asset cost, based on cookstove programs from Sudan, Rwanda and Kenya. A grid-connected PoA is modelled for a portfolio of five 5MW small hydro power plants (SHPP), inspired by CDM projects in Sri Lanka, Guatemala, Honduras and South Africa. The fourth example represents a 40MW onshore wind project. Assumptions and data are taken from sources like UNFCCC (CDM Database), KfW (PoA Blueprint Book), and IRENA (Renewable Power Generation Costs). Details for each case are to be found in Annex 1.

The second part of section 2 analyses the risks of (pre-) financing household energy access programs (that is mainly CER delivery), and discusses mitigation and allocation options on various levels. It shows that, in addition to Ci-Dev's risk assessment and management at ERPA level, a gradual pre-finance structure (for example over the lifetime of the equipment) can further mitigate the delivery risk at a pre-finance level.

Section 3 discusses potential CER pre-finance instruments. A donor-funded reimbursable grant facility is presented as the perhaps easiest and quickest way for demonstrating the relevance and the feasibility of CER pre-finance in the Ci-Dev context. For scaling up CER pre-finance in the future, it then compares different instruments that could also involve the private sector (layered fund, green bonds and securitization). A decision tree illustrates the main questions that have to be answered for selecting the most appropriate instrument. Section 4 briefly outlines funding options for the reimbursable grant facility and a layered fund.

2. Particularities of household energy access programs

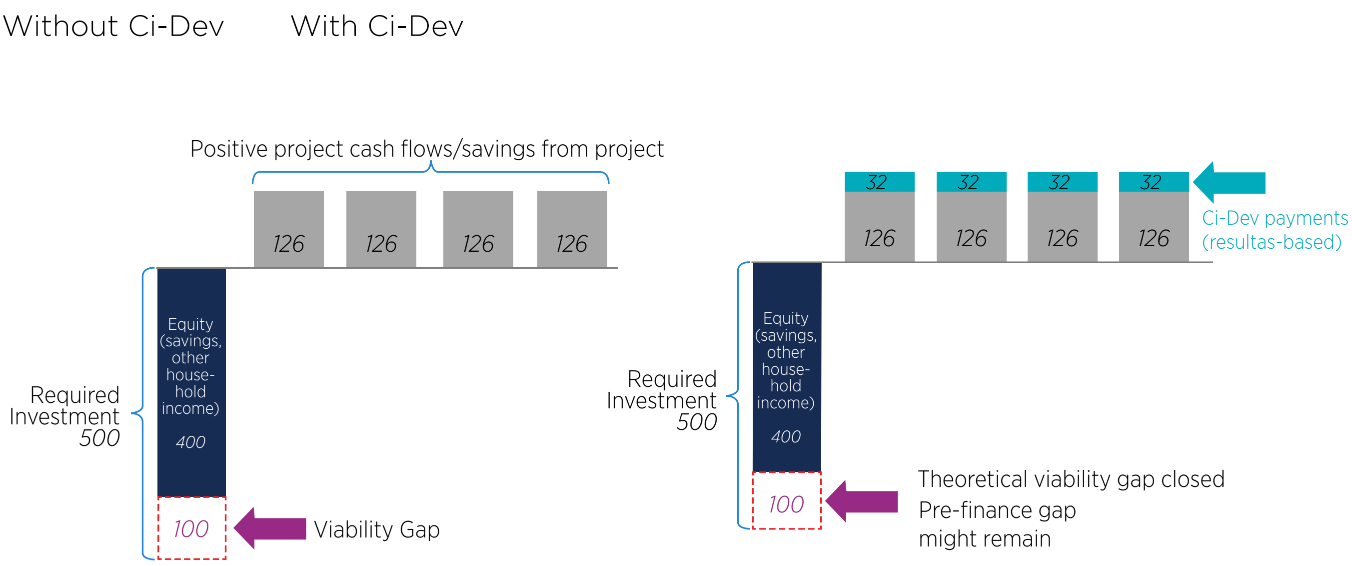
In many developing countries – especially LDCs – clean energy access technologies are not affordable and/or not attractive at a household level. Firstly, households often have low/no income, which limits the possibility to generate savings (equity). Secondly, microfinance products are not commonly used for financing clean energy technologies, particularly if the debt is required to be serviced (partly) from future savings on traditional biomass or fossil fuels. Financial institutions lend against the creditworthiness of the borrower, which is often very limited for rural households. Thirdly, the financial planning horizon of households (weeks to months) is often shorter than the amortization period of the clean energy investment (months to years). Households prefer – or have no other choice than to spend a relatively high amount per month on kerosene, liquefied petroleum gas (LPG) or wood, compared to investing in a clean energy technology that only pays off after several months or even years.

Several CDM-registered programs from public and private sector support households in accessing clean energy by offering systems at lower cost or by handing them out free of charge. Initiatives like Ci-Dev in turn purchase CERs from these programs – thereby indirectly supporting affordability and attractiveness at household level. CERs are an (additional) revenue stream at program level that can be passed on to households, for example by lowering initial system costs (and hence lower amortization period). Using this example and looking at the financial viability of an energy access technology like biogas digestors, CER revenues can be thought of as an additional saving at household level (from using biogas instead of relatively expensive kerosene or LPG). However, households and programs may not be able to purchase the technology in the first place given the CER pre-finance needs as discussed in section 1.

Figure 2 illustrates the current challenges. Without a carbon fund like Ci-Dev, the discounted savings resulting from an exemplary household investment (nominal 126 USD p.a.) are lower than the initial capital expenditure (500 USD), and are therefore not sufficient to achieve financial viability; the net present value (NPV) is negative under an assumed lifetime of four years and a discount rate of 10 percent. Additional results-based payments of Ci-Dev (32 USD p.a.) can close the investment's financial viability gap (positive NPV). While these CER revenues do not reach the household, households can benefit for example by lower initial system costs (400 USD) or free maintenance (equivalent to 32 USD p.a.) offered under the CDM program.[11] However, an initial funding gap of 100 USD might still remain and prevents either the household or the program from purchasing the clean energy technology in the first place, assuming that future CER cash flows cannot be pre-financed.

[11] In the case of maintenance support, the 32 USD p.a. in Figure 2 have to be understood as a positive net cash flow.

Figure 2: Equity pre-finance requirements of an illustrative household investment



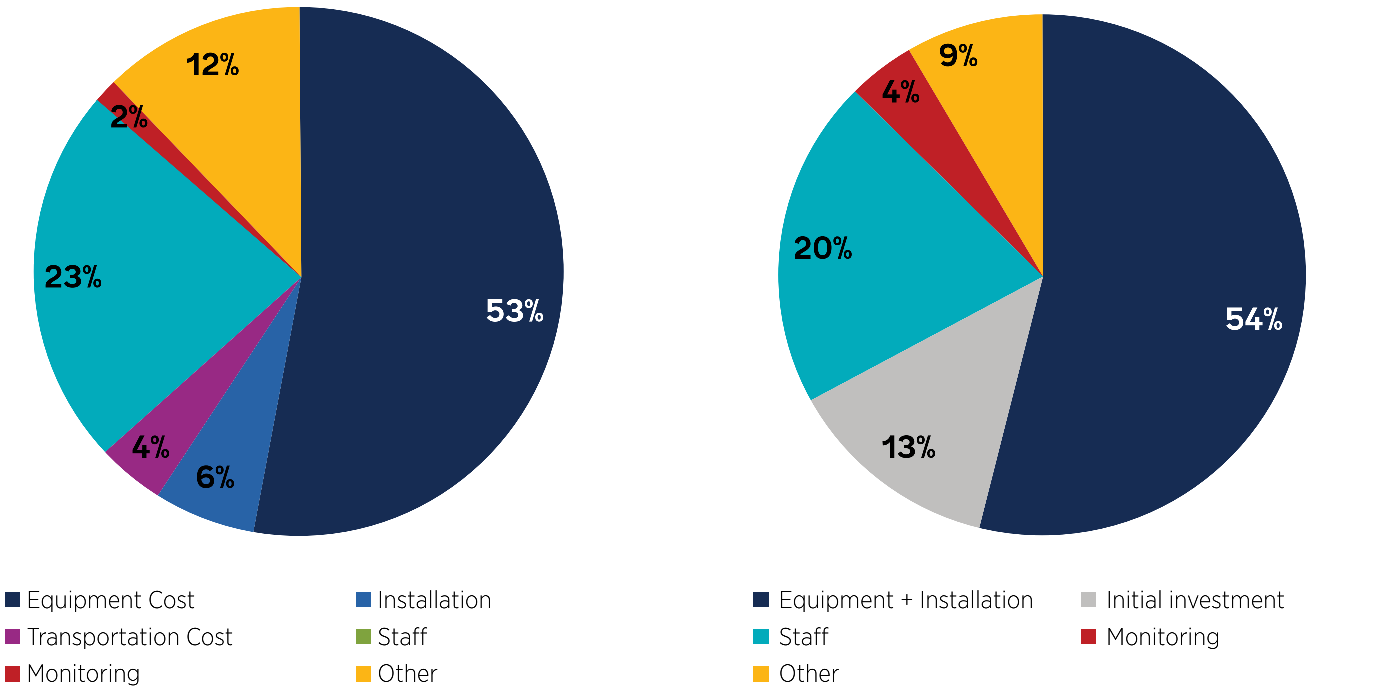
The following sub-sections discuss the particularities of household energy access programs, using the example of Ci-Dev. Section 2.1 shows that the cost and financing structure of CDM programs is accompanied with the problematic and difficult task of earmarking funds for a specific purpose – a challenge particularly relevant for CER pre-finance. Section 2.2 discusses the relevance of CER revenues and CER pre-finance needs for different types of low-carbon technologies and compares household energy access programs to larger-scale RE projects. Finally, section 2.3 maps the risks of household clean energy programs at different levels, and presents different mitigation and allocation options.

2.1. Program cost structure

The affordability, attractiveness and financial viability of household clean energy technologies depends to a certain extent on the cost and revenue structure – including pre- and re-financing options[12] – of CDM programs. While carbon revenues often account for a significant share, in general, CDM programs can have more financing sources than "only" CER off-takers. Private-sector-led programs are often financed by equity, specialized debt funds and commercial banks. NGO-led programs typically depend on ODA grants and local government support. PPP programs are often supported by credit facilities of international financial institutions. Yet, the initial business plans of these programs do not usually earmark (possible) financing sources to an intended purpose or individual cost component. The actual financing structure, provided volumes and disbursement schedules (of grants, soft loans etc.) can be quite intransparent, even at a stage when already CDM-registered programs apply for carbon finance to fill a remaining gap.

[12] Pre-financing refers to financing of future cash flows (as for instance CER revenues). Re-financing refers to the (usually retroactive) financing of an existing financing from different sources and/or under different terms and conditions. However, especially in LDCs, re-financing credit lines are often a pre-condition for local banks and MFIs to provide finance in the first place, and therefore also have kind of a pre-financing character.

Figure 3: Cost structure of two Ci-Dev cookstove programs



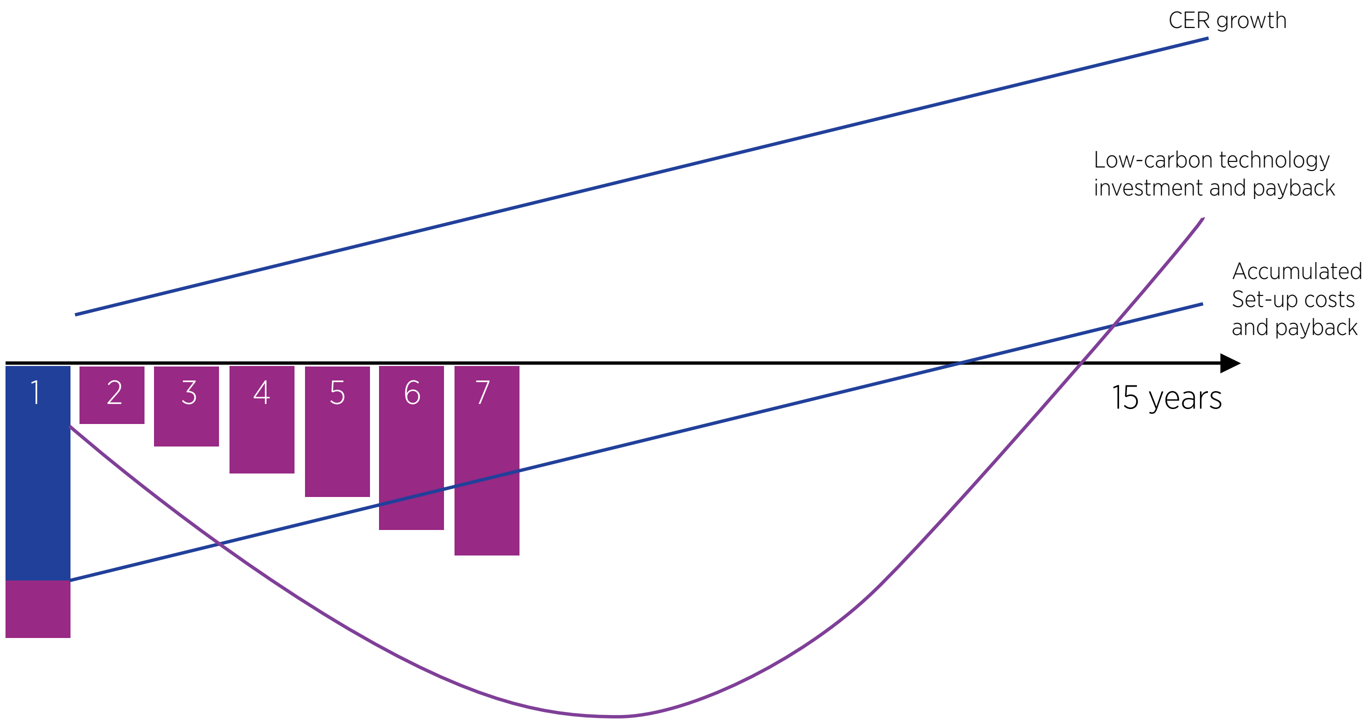
The uncertainty regarding the application of funds can have an impact on the risk profile of CER pre-finance. Ci-Dev applies a "goal seek" on the entire business plan – that is over the project lifetime – by i) assessing the overall CER delivery potential, ii) determining the maximum CER volume to be contracted (delivery risk mitigation), and iii) determining the CER price required for closing the project's financial viability gap.[13] Theoretically, a CER pre-finance instrument can "only" address the financing gap that can be closed by CERs. Yet, in practice, pre-finance would only be provided step-by-step, for example for three to four years. It will be difficult to determine whether i) the pre-finance funds in that period would be used exclusively for the actual emission-reducing – and hence CER-generating – purpose in that period (that is purchasing and selling/distributing low-carbon energy access systems); or ii) whether and to what extent funds would be used for other program activities that are not directly linked to immediate CER generation (such as market research and long-term business development). In the latter case, the pre-financing (after three to four years) has to be paid back by other sources than CER revenues, thereby exposing the pre-financing institution to risks beyond the carbon-related risks (see also section 2.3).

Section 2.2 addresses CER pre-finance needs in more detail, and differentiates between four types of CDM projects. For interpreting the results, it has to be considered that the causes of a financing gap – just like the financing sources from which the gap will be closed – are not (always) known. Hence, CER pre-finance needs have to be understood as overall financing needs that can possibly be addressed by CER pre-finance.

Figure 4 illustrates the program cost amortization of an exemplary PoA (15 years lifetime). It is assumed that a household-scale low-carbon technology with a lifetime of three years is distributed for seven years, with yearly increasing distribution rates. The initial program set-up costs have a similar amortization to the investment in the household energy access technologies and only amortize towards the end of the PoA lifetime.

[13] In other words, the goal seek in this context is a reverse calculation of the CER price (dividing the financial viability gap by the expected number of generated CERs).

Program cost amortization :4 Figure



2.2 Determinants of CER pre-finance needs

The relevance of CER revenues as part of the overall revenue stream can differ quite significantly between CDM project types (that is household-level PoAs, grid-connected PoAs, and stand-alone projects) and asset classes (that is low-carbon technologies). Table 1 shows for two selected Ci-Dev programs – both on household level – the ratio of CER revenues and "ordinary" revenues (end-user price) per unit sold of the respective small-scale RE technology. CER revenues add another 45 percent of the end-user price to total revenues achievable under a domestic biogas program in Kenya, and add another 400 percent of revenues on top of ordinary revenues from selling an ethanol stove in Madagascar.

Table 1: End-user price vs. CER revenue per unit[14]

Project	End-user price (USD)	CER revenue (USD) [15]	Carbon share
Kenya Simgas	910	410	45%
Madagascar Ethanol Stove	75	300	400%

[14] Based on confidential assumptions.
[15] Carbon revenues assumed at 100 percent system performance and full offtake at given prices.

In other words, CER revenues can significantly contribute to the financial viability of household energy access programs, and could, amongst other things, be used to make technologies for end-users more affordable (or more attractive). Affordability of technologies is particularly important since households in LDCs rarely have access to debt finance (micro loans), and have to purchase low-carbon technologies based on their income and savings. Pre-finance on an ERPA level has the potential to leverage other external financing sources. For instance, a microfinance institution (MFI) might be more willing to offer a loan product for pre-financing low-carbon technologies knowing that international donors (investors) have a stake as well. Yet the ERPA pre-finance should not be used as first-loss facility for MFIs as this would increase the repayment risk and discourage (private) investors. In order to mitigate risk at pre-finance level, funds should be used as far as possible for CER generation itself (see also risk mitigation options in section 2.3.2).

This is different for grid-connected PoAs (like a portfolio of small RE plants) and large stand-alone projects, where CER revenues are not as relevant for the activities' financial viability. Despite possibly larger carbon finance requirements in absolute numbers, the relative share of CER revenues compared to ordinary project cash flows (that is usual revenues from electricity sales) is rather small at carbon prices around 10 USD/t. Decreasing technology costs – PV modules being the most prominent example – have additionally reduced the financial viability gap.

Table 2 shows the share of carbon revenues (in total project revenues) for four exemplary projects that are representative of the overall CDM pipeline. The two simulated household energy access programs are inspired by the West Africa Biodigestor PoA (financing of program costs) and by clean cookstove programs from Sudan, Rwanda and Kenya (co-financing of asset cost). The grid-connected PoA is modelled for a portfolio of five 5MW small hydro power plants (SHPP), inspired by CDM projects in Sri Lanka, Guatemala, Honduras and South Africa. The fourth example represents a 40MW onshore wind project.[16] For the two household-level programs, the share of carbon revenues is 85 percent if used for co-financing the asset cost and 100 percent if financing program costs. On the other hand, the share of carbon revenues is less than 10 percent for grid-connected power plants.[17]

Table 2: Carbon revenue share of representative CDM projects

Project	Revenue (USDm)			Share of carbon revenues in total project revenues
	Carbon	Other	Total	
Energy solutions at HH level – finance for program costs	1.7	0.0	1.7	**100%**
Energy solutions at HH level – finance for asset cost	1.7	0.3	2.0	**85%**
Portfolio of small RE plants	12.9	184.9	197.9	7%
Stand-alone RE power plant project	8.8	210.2	219.1	4%

[16] Assumptions and data sources are to be found in Annex 1.

[17] Calculations are based on a goal seek for carbon prices. The more competitive renewable energies become, the less Ci-Dev might pay per CER. The shares of carbon revenues might be different for fixed prices.

CER pre-finance needs can also differ quite significantly between project types and asset classes. Under a household-level PoA, financing needs for assets, administration and support services often increase over time (along with the number of installations and program implementers). On the other hand, the financing of grid-connected PoAs and stand-alone projects – particularly under a project finance structure – requires significant upfront investment for construction and commissioning of the plant(s). For larger power generation assets, as illustrated in Figure 8 and Figure 9, the capital expenditure in the first year(s) is significantly higher than operational (or replacement) expenditures over the lifetime of a project.

Figure 5: Projected yearly CER volumes of selected household energy access programs (indexed to 100 in year 1)[18]

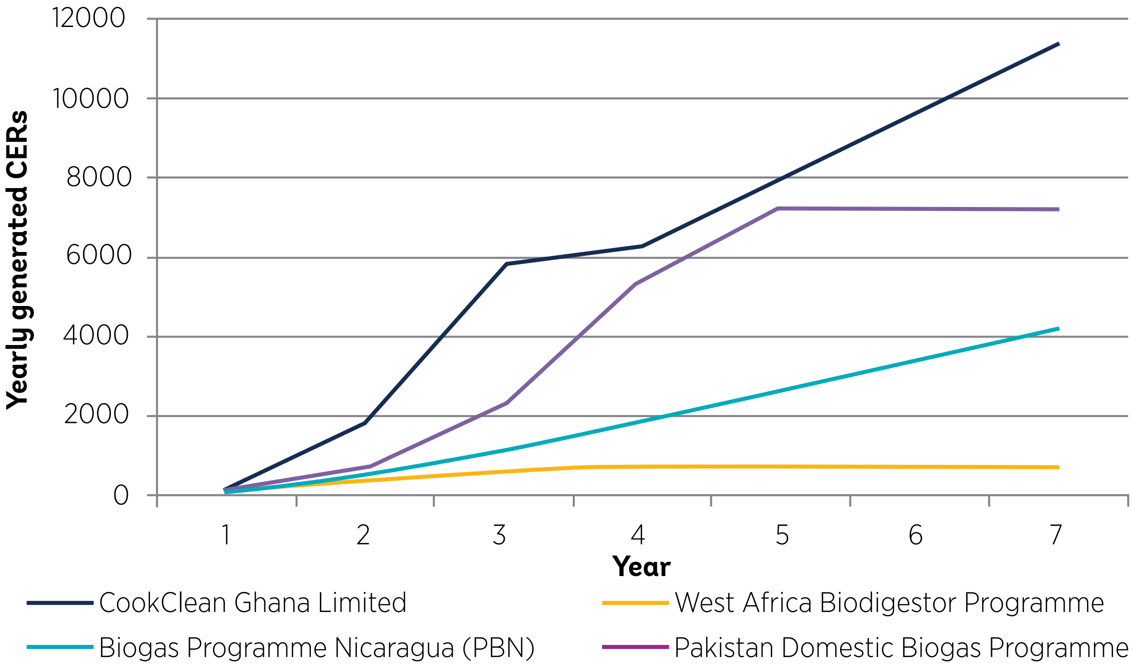


Figure 5 illustrates the CER growth rates for CDM household energy access programs from West Africa, Ghana, Pakistan and Nicaragua. Typically CDM programs are designed to be expanded over time, and usually have relatively limited financing needs in year 1. Initial financing is required for the overall program set-up and purchasing of the first low-carbon energy systems – and is relatively low compared to, for example, stand-alone projects such as MW-scale RE power plants. Hence, a full pre-financing of the projected carbon cash flows to year 1 appears unnecessary as capital employed only increases over time in line with higher market penetration. Full pre-financing would create unproductive cash buffers on the balance sheet of the CME or CPA Implementer (and they would only utilize the funds over the lifetime of the PoA when purchasing additional installations).

Nonetheless, household energy access programs can have prohibitively high pre-finance needs that prevent program initiation. Different to larger power generation projects, pre-finance of carbon revenues can be the crucial element in facilitating activity implementation. Table 3 shows the pre-finance needs and other key features of the four exemplary project categories.

[18] Assumptions and data sources are presented in Annex 2.

Table 3: Pre-finance potential of different project/asset types

Project	Amounts (USD million)		Required timing of pre-finance	Payback time of assets	Lifetime of assets
	Carbon only	Incl. asset financing			
Energy solutions at HH level – finance for program costs	0.1 – 0.5	N/A	Irregular, depending on other sources	N/A	N/A
Energy solutions at HH level – finance for asset cost	0.5 – 2.0	0.5 – 10.0	Staged payment in initial years	3 – 5 years	3 – 7 years
Portfolio of small RE plants	0.5 – 10.0	10.0 – 50.0	Staged payment in initial years	7 – 15 years	>20 years
Stand-alone RE power plant project	5.0 – 30.0	20.0 – 100.0	Full payment in year 1	7 – 15 years	>20 years

2.2.1 Energy solutions at household level – finance for program costs

Household-level programs typically support access to small-scale RE technologies like biogas digestors, solar home systems, solar water heaters, and efficient biomass cook stoves. The given example is inspired by a Ci-Dev biodigestor project in West Africa; in the CDM pipeline similar cases exist for instance in Nicaragua, Pakistan and Vietnam. Common features are that the per-unit costs are relatively low (especially if compared to grid-connected power plants), and CER revenues are by far higher than ordinary revenues from system sales (in the given example, CER revenues are the exclusive revenue stream on program-level).

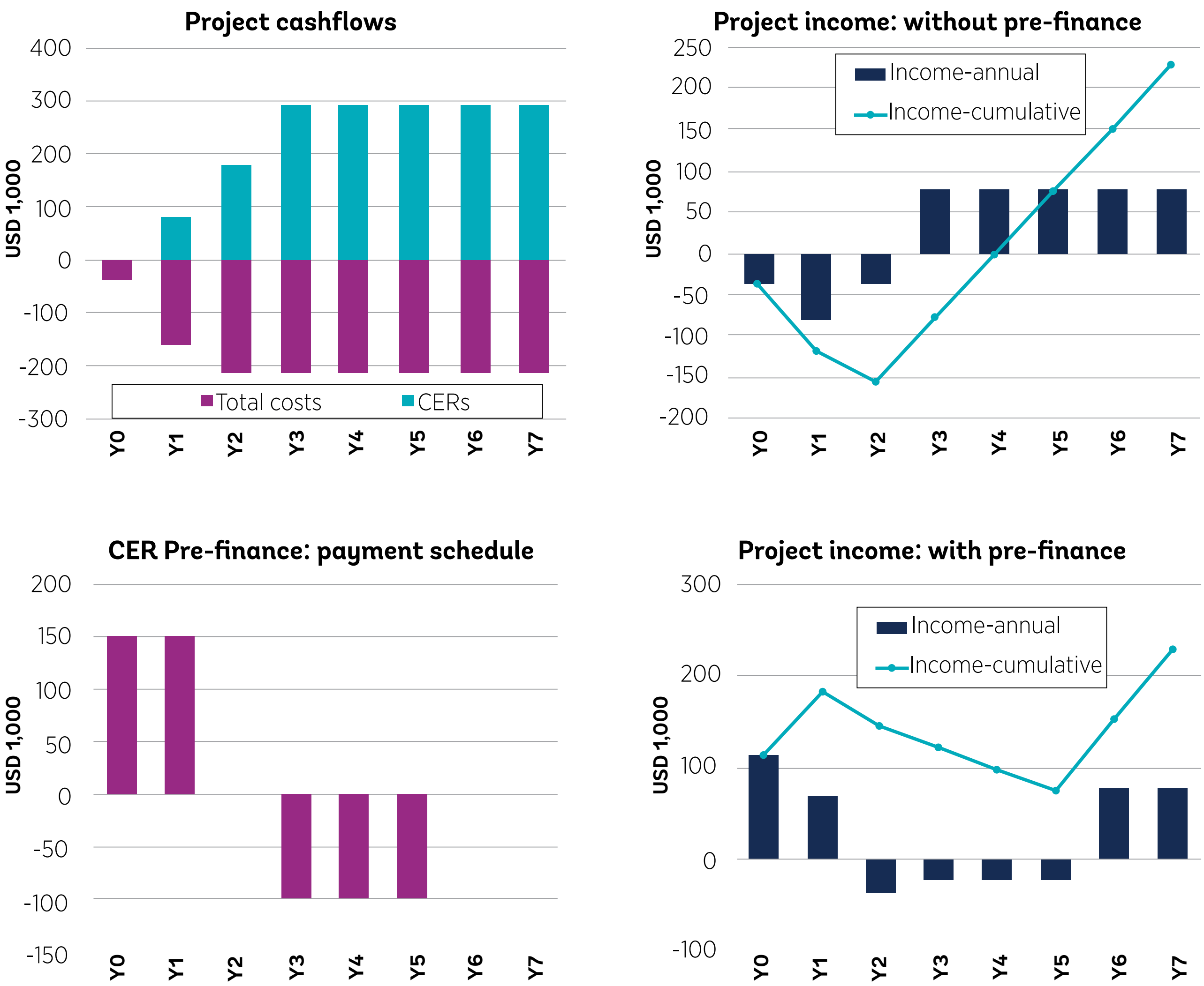
In theory, especially for programs in which the capital expenditures for low-carbon technologies are fully grant-financed, carbon finance is mostly required for the maintenance and/or program costs such as innovative monitoring systems, service centers and performance-based maintenance subsidies.[19] Typically, these costs occur only once units have been deployed, meaning that cash outflows more or less match inflows in any given year. For instance, for the West Africa project, the financing needs for the support of a performance-based subsidy for 9,000 biogas units amount to 150,000 USD in the second year (Figure 6, green curve in top right quadrant).[20]

Yet, in order for the project to have a constantly positive income, finance requirements in the first years are higher. The exact amount and repayment profile will depend on individual cases as well as the structure of the pre-finance instrument. For the given illustrative example, 300,000 USD have to be paid back after five years.

[19] As outlined in section 2.1, the initial business plans of those programs do not usually earmark (possible) financing sources to an intended purpose or individual cost component.

[20] For the biogas program in West Africa, (pre-) finance is also required for research and development, product optimization, marketing and demand creation. Other donor funding was provided to start the implementation.

Figure 6: Cash flows and maintenance pre-finance needs of a biodigestor PoA

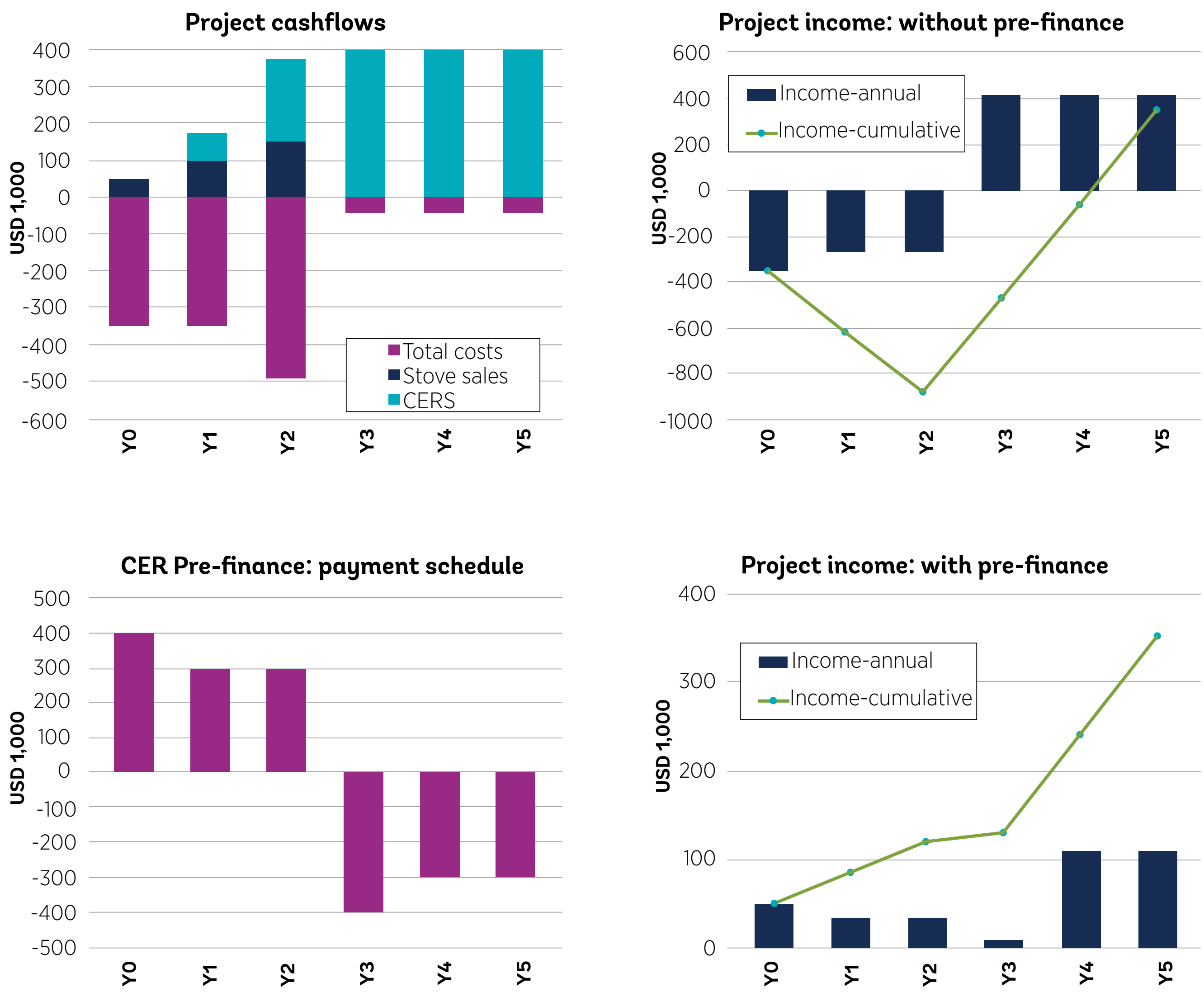


Limiting pre-finance to program costs and maintenance is of course only applicable to cases where households can afford the initial system costs, have access to (micro-) finance, or where systems are handed out for free. Especially for programs implemented by an NGO or PPP, pre-finance at the consumer level is often provided by credit facilities of International Financial Institutions (IFIs). However, in general, the coverage of household PoAs could perhaps be increased if households cover system maintenance themselves, and if CER pre-finance is used to contribute to the asset cost of the clean energy equipment.

2.2.2 Energy solutions at household level – finance for asset cost

Financing part of a clean energy technology's asset value is common practice under the CDM, and Ci-Dev supports such projects. As pointed out above, per-unit costs are relatively low. However, besides technology costs, financing needs depend on the size of the project portfolio/PoA and on project-specific deployment schedules. In case units are mainly deployed in the first years, pre-financing needs are higher than if deployment gradually scales up over time. For a simulated cookstove project with 30,000 units (similar to CDM projects in Sudan, Rwanda and Kenya)[21], CER revenues account for 85 percent of overall revenues, and pre-financing needs of one CPA cumulate to approximately 900,000 USD over the first two years (Figure 7). Yet, following the logic above, approximately 1 million USD has to be provided over the same timeframe to maintain an overall positive project cash flow (green curve in the bottom right quadrant).

Figure 7: Cash flows and asset pre-finance needs of a cookstove CPA



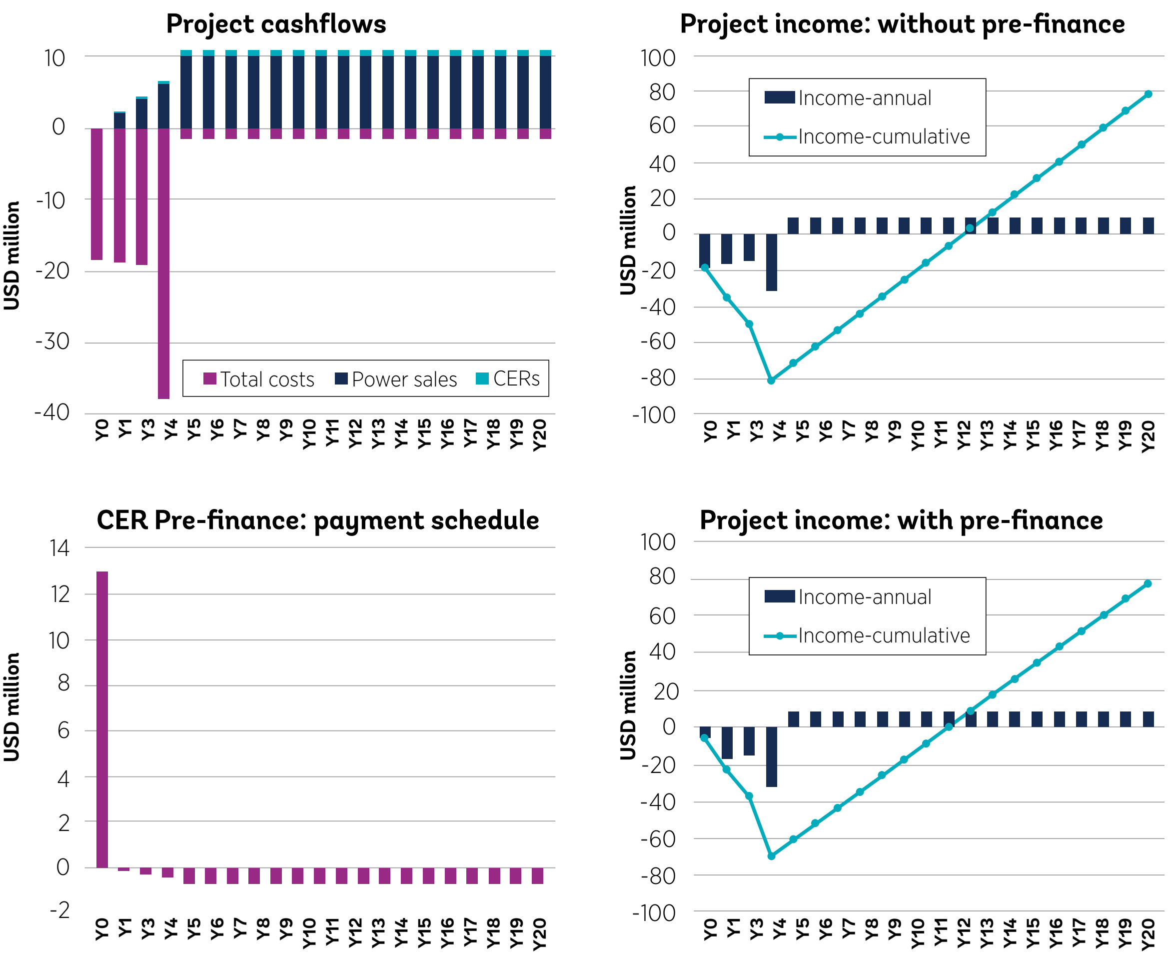
[21] See Annex 1 for data sources and assumptions.

Programs utilizing such a support category are often implemented by private companies that have access to debt financing once ERPAs have been signed. In this case, external debt providers could be considered as an already existing source for pre-financing – including CERs which account for the largest part of revenues. Yet Ci-Dev experience with household energy access programs has shown that a number of programs that rely on carbon finance in the form of asset cost subsidies cannot be initiated. There is still insufficient access to pre-finance; this lack of access presents a high barrier to activity implementation. Hence pre-financing carbon revenues has significant potential to facilitate the realization of scalable CDM projects.

2.2.3. Portfolio of small RE plants

For small grid-connected RE plants, overall financing needs are significantly higher (and project lifetime and payback periods are significantly longer) than for household energy solutions. For instance, pre-financing needs for a portfolio of five 5MW SHPPs[22] amount to approximately 80 million USD over the first three years (Figure 8). However, in the given example, carbon revenues only account for 7 percent of total revenues and could – even if all future CER revenues were pre-financed – only cover a very small share of the initially required investment.[23] The sale of electricity would remain the major revenue source. For larger power generation projects – as also shown in the next example – carbon revenues and CER pre-finance are hardly the decisive factor for financial viability. As mentioned above, pre-financing of CERs is much more relevant for household-level energy access programs than for larger-sized power projects.

Figure 8: Cash flows and asset pre-finance needs of a PoA for grid-connected SHPPs



[22] Simulation based on CDM projects in Sri Lanka, Guatemala, Honduras and South Africa. See Annex 1 for data sources and assumptions.

[23] As mentioned above, calculations are based on a goal seek for carbon prices. The shares of carbon revenues might be different for fixed prices.

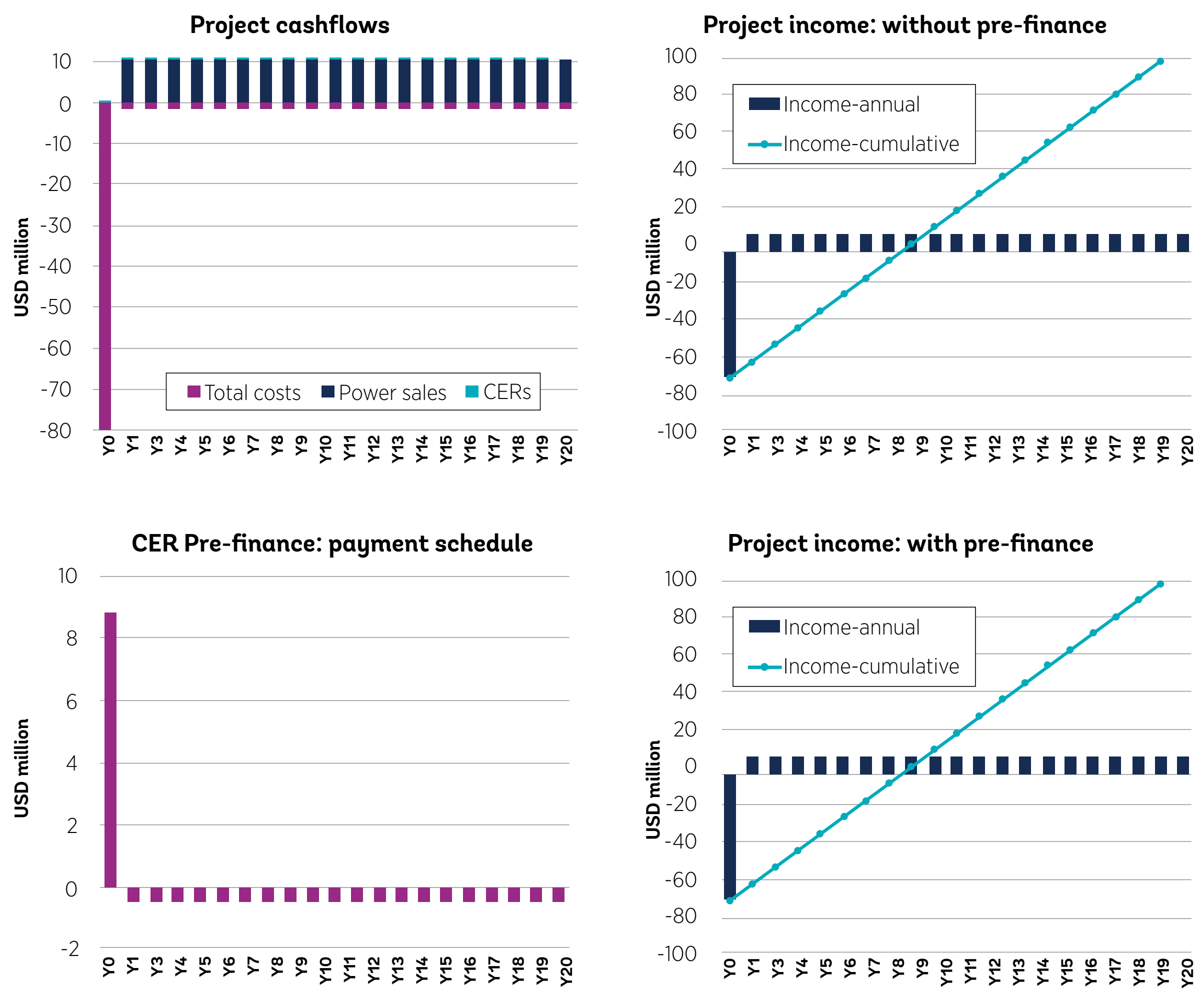
2.2.4. Stand-alone RE power plant

For larger RE projects such as a 40MW onshore wind farm[24], overall pre-financing requirements can be even higher in single years (approx. 80 million USD in the first year as shown in Figure 9). However, in the given example, CER revenues only account for 4 percent of total revenues over the project's lifetime (also driven by decreasing technology prices over recent years).

Projects of such size can anyhow only be realized if sufficient debt is available for financing large parts of the capital expenditure. Under a project finance structure (with no/limited recourse to the project sponsor), a bank's risk assessment is entirely based on future cash flows. As shown in the top left quadrant of Figure 9, revenues of grid-connected power plants usually amount to more than 90 percent of electricity sales – that is non-carbon revenues.

Different from household energy access programs, it is not expected that a market-based CER pre-finance instrument could unlock any additional transactions (it would rather increase transaction costs and would consequently not be used). It is quite unlikely that a grid-connected power plant cannot be realized due to missing CER pre-finance. Revenues from CERs are rather an add-on that is not necessarily essential for financial viability. The pre-financing of ordinary project revenues from electricity sales (as done by the project finance loan) demonstrates the general ability of the financial market to pre-finance cash flows of a power generation project – which could then also be applied to CERs.

Figure 9: Cash flows and asset pre-finance needs of a stand-alone wind farm project



24 See Annex 1 for data sources and assumptions.

In the past, pre-financing CER cash flows of stand-alone RE power plants was considered a possible support mechanism in theory and (to a very limited extent) in practice. Today, however, as outlined above, carbon pre-finance seems more relevant and required for household-level energy access programs.

2.2.5. Reasonable level of CER pre-finance

If the current Ci-Dev ERPA volume was pre-financed to 100 percent, total pre-financing needs would amount to 118 million USD (that is the total firm CER off-take volume at an assumed carbon price of 10 USD per CER). However, as mentioned above, this would result in unproductive cash buffers on the balance sheet of the project implementers. Additionally, pre-financing the entire portfolio is not recommended from a risk management perspective as discussed in the following section.

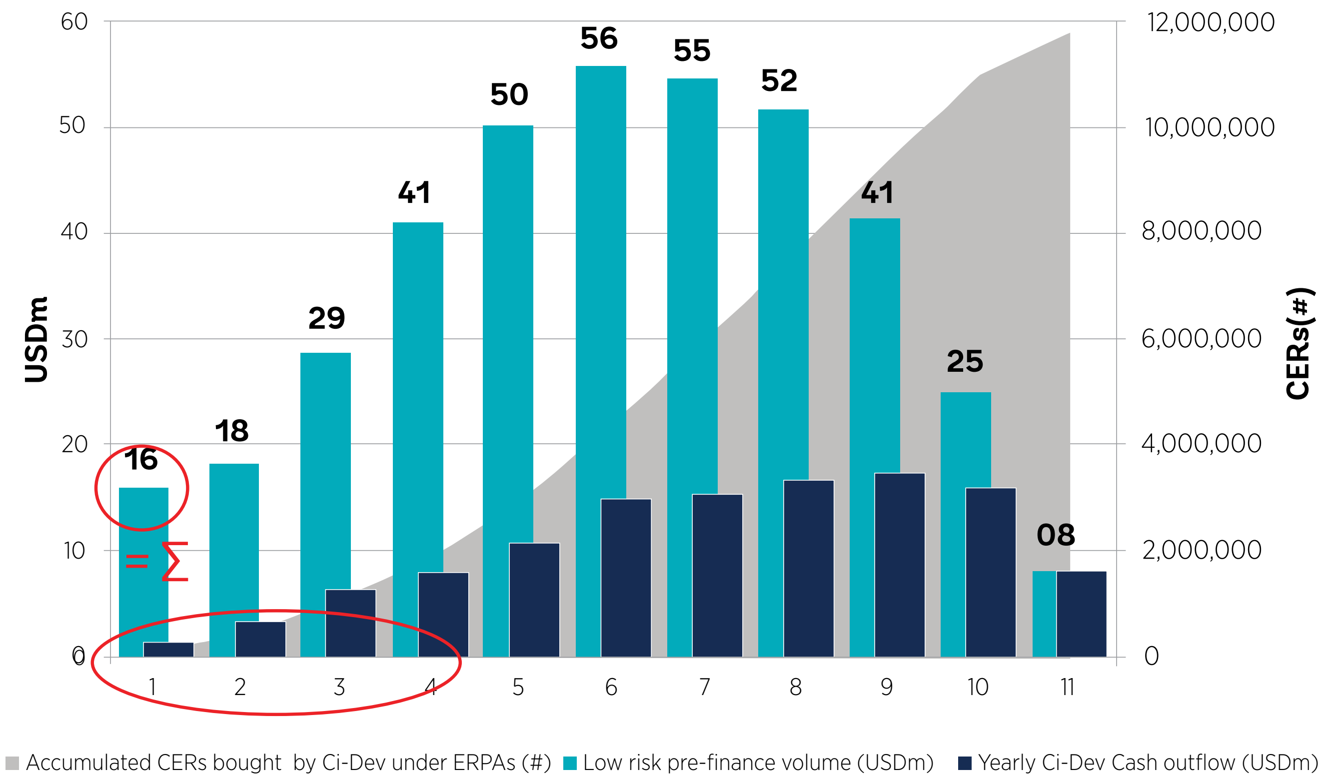
Therefore, for roughly estimating a volume for pre-financing Ci-Dev ERPAs, it is assumed that pre-financing is done periodically assuming a period equal to the lifetime of the respective low-carbon technology. This would mean that only CERs generated during such a period at the program level are pre-financed. Only systems that will be distributed in a given year have to be purchased by the CPA Implementer. By neglecting program set-up costs, only the system costs that occur in that same year have to be pre-financed ("low-risk" approach).

Figure 10 shows the estimated yearly CER pre-finance volumes.[25]The volume of each year is defined as the maximum required fund size in a year, not as additional annual disbursements. For example, a volume of 16 million USD in the first year will be sufficient to pre-finance expected CERs over the assumed minimum lifetime of the different low-carbon technologies (weighted average of four years). The same logic applies to the maximum fund size of 56 million USD in year six, which is the sum of expected CER payments (that is Ci-Dev cash outflows) for CERs generated over the lifetime of equipment deployed in that year.

It is important to note that this approach does not consider other pre-financing sources (like grants or IFI credit lines) that the projects might have already secured. Consequently, the 56 million USD represents the upper limit of required pre-financing – if the pre-finance vehicle should not take any non-carbon risk.

[25] A step-wise methodology was used to estimate the CER pre-finance volume: i) Calculating of yearly Ci-Dev outflows for individual projects based on CER prices and off-take volume from draft ERPAs; ii) Estimating pre-finance volume by adding up yearly outflows over estimated lifetime of individual low-carbon technologies; iii) Summing up pre-finance volume of individual projects to get overall pre-finance volume. See Annex 3 for details.

Figure 10: Estimated CER pre-finance volume



2.3 Risk analysis

Section 2.2 outlined finance volumes and pre-finance needs of different project types, and a possible portfolio of household energy access programs that could be supported by a CER pre-finance vehicle. It was found that – by means of CER pre-finance – carbon finance activities of initiatives like Ci-Dev could be expanded from mainly maintenance (and other admin and support measures) towards asset finance on household level – thus increasing the impact by also allowing end users with limited savings and other household income to benefit. To a lower, still to be critically assessed extent, this might also apply on grid-connected level.

The section below discusses the second key determinant for pre-financing carbon cash flows – that is risks of different project types and technologies – and suggests risk mitigation and allocation options on individual ERPA level, pre-finance contract level, portfolio level, and on the level of a CER pre-finance instrument.

2.3.1. Risk mapping

Several risk categories are relevant for household energy access programs and CDM projects in general. The most obvious and most relevant risk for the majority of CDM projects is CER delivery – depending on the actual project performance and the local market, but also on CDM regulations and processes as well as country-specific (political) matters. Besides, there could be counterparty (off-take) risks and CER price risks. The latter two, however, are not as relevant in the context of a carbon fund like Ci-Dev that is backed by sovereigns, and for which prices are pre-defined in individual ERPAs.

Delivery risk

Delivery risk – that is the risk that supported mitigation activities do not result in the targeted emission reductions – can be quite significant for household energy access programs. The success – and hence the risk – of CER issuance[26] vary across and among CDM project categories. For example, for household-level projects and smaller grid-connected projects similar to the cases presented in section 2.2, UNEP DTU data shows that solar projects are the least risky (91 to 99 percent average issuance success), whereas cook-stove projects come with the highest risk (26 to 66 percent issuance success; 45 percent average).

Table 4: Project performance across different project categories[27]

Technology	Scale	CER issuance success	Sample[28]
Solar water heating	Household	99%	2
Solar PV	Grid	96%	27
Solar cooking	Household	91%	8
Run-of-river hydro	Grid	85%	538
Wind	Grid	84%	822
Bagasse power	Grid	82%	62
Rice husk power	Grid	82%	69
Domestic manure	Household	79%	12
Landfill power	Grid	59%	75
Cook-stoves	Household	45%	4

In addition to differences in average issuance success, different technologies have different patterns in terms of CER issue success variance (risk distribution). An issue success analysis of grid-connected[29] RE projects (see first six charts in Figure 11[30]) shows that “simpler” RE technologies like hydro, wind and PV follow a Gaussian curve, whereas more complex technologies involving fuel supply risks (for instance landfill or bagasse power) follow a more varied distribution. Hence fuel-based RE projects do not only come along with a lower average issuance success (see again Table 4), but also with a higher uncertainty regarding their performance (higher standard deviation).

[26] CER volumes are determined by ex-post monitoring and verification of the PoA. Parameters to be monitored are CDM methodology-specific. The UNFCCC Standard for sampling and surveys for CDM project activities and programme of activities provides guidance on statistical methods to be applied.

[27] Source: Own analysis based on UNEP DTU CDM Pipeline. CER issuance success refers to average actual (validated) CER issuance vs. CER issuance projected in the original CDM project design document (PDD).

[28] Data on project evaluation and issue success is mostly available for the CDM period before PoA became a commonly used approach. Hence the sample includes mainly grid-connected projects, and only relatively few projects for household-level technologies. Results for the household-level are not necessarily representative.

[29] For household-level technologies, the sample size is too small for preliminary conclusions on risk distribution patterns. Yet, as shown in Table 4, performance projections have been overly optimistic in many of the cases.

[30] The horizontal axis shows the range of CER issue success (0 to 200 percent); a success rate of more than 100 percent means that the project or program generated more CERs than the amount projected in the CDM PDD (over-performance). The vertical axis shows the number of projects among the selected sample that delivered a particular success rate.

Figure 11: Distribution of CER issue success rate

Two key components of delivery risk are market risk (that is projected vs. actual deployment; also called scale-up risk) and performance risk (projected vs. actual emission reductions at the unit level). For example, for an efficient cookstove project in Lesotho (CDM Ref. 5482), UNEP DTU reported an overall issuance success of 54 percent. In respect of market risk, i) program dropouts were higher than expected (10 percent instead of 5 percent), ii) the use of baseline equipment (that is older, previously existing, "high-carbon" equipment) was more frequent than expected (88 percent instead of 80 percent), and iii) equipment deployment was slower than expected. As far as performance is concerned, the efficiency of new stoves turned out to be lower than expected (43 percent instead of 52 percent).1

Successful delivery of CERs also depends on the sustainability of the business model. If the business model is not sustainable, the scale-up will not happen beyond a certain point. The "sustainability risk" in turn is most likely lower for projects that are based on successful pilots. On the one hand, Ci-Dev supports some business models that are completely new and thus will have a slightly higher risk profile, whereas others are based on established proof of concept. The delivery risk at the portfolio level is expected to be balanced in this regard (see also section 2.3.2). Sustainability and scale-up of programs also depend on access to long-term (or revolving) finance like the proposed pre-finance facility for CER revenues.

Risks related to CDM regulations and processes

Regulatory risks relate to two steps of the CDM project cycle: Registration and CER issuance. The highest (yet limited) risk has been registration with the UNFCCC. According to UNEP DTU, until June 2016, 549 of 8,264 applications for standalone projects (6.6 percent) were rejected by the CDM Executive Board (EB) or the Designated Operational Entity (DOE).2 The rejection rate for PoAs was considerably lower (3 out of 297; ~1 percent). In any case, this risk is very limited for carbon (pre-finance) funds that invest in energy access projects. Many of those projects fall under the micro-scale auto additionality rule[33]; in case of doubt, the fund can mitigate that risk by including successful registration as a condition precedent.

Before registered projects can request CER issuance, the DOE has to verify the monitoring report. With the introduction of PoAs, the complexity of measuring greenhouse gas (GHG) emission reductions – and hence the risk that monitoring was not carried out properly – has increased. More precisely, there could be problems with the quality and scope of collected data, or with the application of the relevant methodology. In that case, the DOE might not verify the monitoring report and could refuse to forward the issuance request.

Because the PoA modality is still relatively new, it is difficult to quantitatively assess how much the risk related to monitoring, reporting and verification (MRV) has increased compared to standalone CDM projects. One indicator is the share of projects that have published monitoring reports but have not yet requested issuance.[34] Of the 51 PoAs that have published monitoring reports, three have withdrawn their reports, while nine still have their issuance request pending – including a few for which the monitoring report was uploaded more than a year ago.

[31] Values refer to the first monitoring period.

[32] A DOE is an accredited independent auditor that validates project proposals and verifies whether implemented projects have measured their GHG reductions according to the prevailing UNFCCC rules.

[33] For projects that are located in LDCs and that are below the following thresholds, additionality is granted automatically: i) RE projects < 5MW; ii) EE projects < 20 GWh/year savings; and iii) other projects < 20 kt/year CERs.

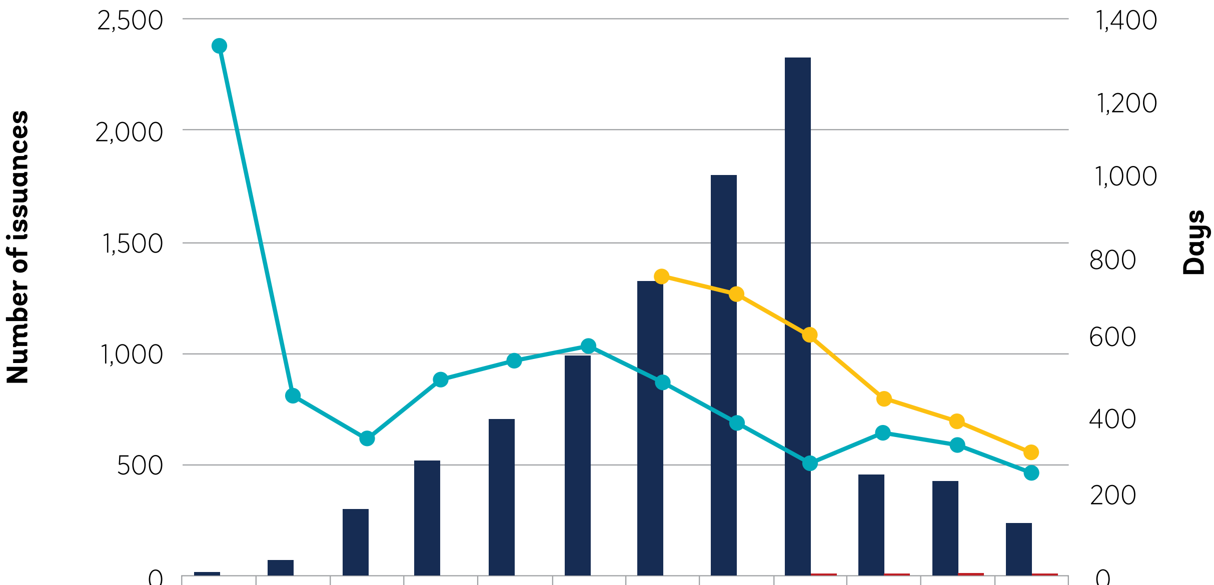
[34] In the CDM project cycle, the project implementer forwards the monitoring report to the DOE, which in turn publishes it on the UNFCCC website. Once published, the DOE starts the verification process and, upon successful completion, requests CER issuance from the UNFCCC.

As a last step, the DOE has to request CER issuance from the UNFCCC. The risk that the UNFCCC rejects the issuance request is relatively small. According to UNEP DTU, 8,817 monitoring reports from standalone CDM projects have been approved for issuance, while only 20 requests have been rejected. For PoAs, out of the 54 issuance requests, the UNFCCC has only rejected one, and asked for review of a second one.

Finally, even if the issuance request is approved, the time-lag between request and actual issuance might affect returns. According to the Institute for Global Environmental Strategies (IGES), the average time for issuance (measured as the time-lag between end of the monitoring period and issuance of CERs from standalone CDM projects) followed a decreasing trend until 2012, and started to increase again slightly after 2012 (see Figure 12). Most likely, post-2012, CDM project owners have been feeling less pressure to prepare and forward issuance requests.[35]

The decreasing trend in Figure 12 is perhaps related to a sample bias. For recent years, the projects for which issuance takes longer are not yet reflected in the statistics since the actual issuance has not taken place. The difference between PoAs and standalone CDM projects is consistent though. The time-lag between the end of the monitoring report and the CER issuance has been longer for PoAs than for standalone projects, reflecting the generally higher MRV complexity of PoAs.

Figure 12: Time lag between end of monitoring period and CER issuance[36]



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
# - CDM	07	66	301	519	702	999	1,321	1,793	2,323	452	429	243
# - PoA							01	02	08	11	14	11
Time to issuance (CDM)	1,331	453	345	489	541	575	486	385	283	360	330	262
Time to issuance (PoA)							751	706	606	447	389	311

[35] An indication for this is that the time-lag between the end of the monitoring period and the publication of the monitoring report has increased.

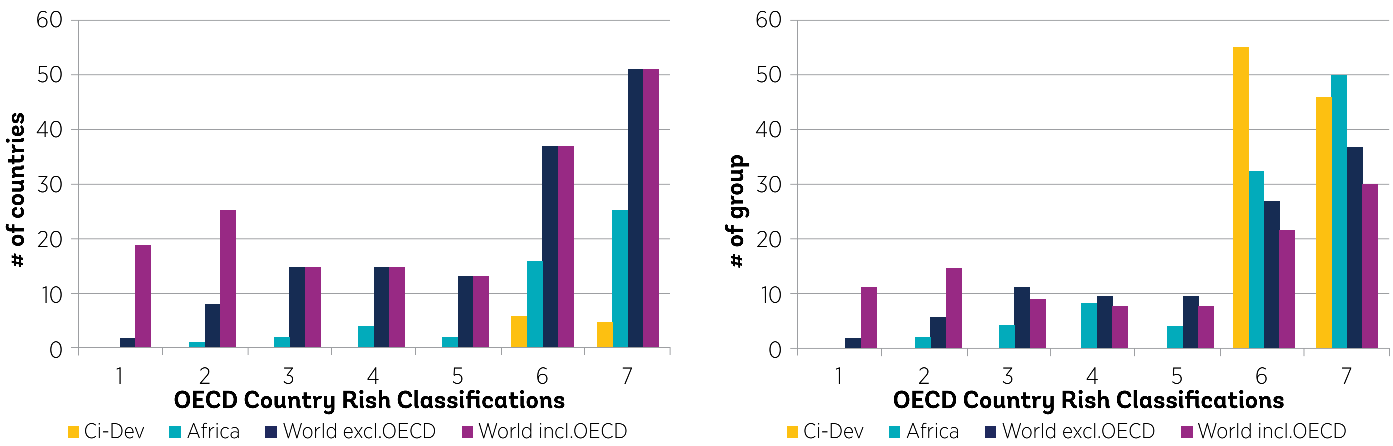
[36] Source: Own analysis based on IGES CDM Monitoring and Issuance Database.

Political risk

According to the Multilateral Investment Guarantee Agency (MIGA), the World Bank's political insurance provider, political risks are associated with government actions (i) that deny or restrict the right of an investor/ owner to use or benefit from his/her assets, and/or (ii) that reduce the value of the firm. Furthermore, political risks include war, revolutions, government seizure of property, and actions to restrict the movement of profits or other revenues from a country.[37]

On the one hand, political risks such as war, expropriation, revolution, and civil disturbance can have a direct effect on CDM projects. On the other hand, for a carbon fund like Ci-Dev, transfer and convertibility risks are not directly relevant since payments are settled off-shore. Nonetheless, issues with transfer and convertibility of the national currency might adversely affect the business of local CDM program implementers – thereby indirectly affecting the performance of the overall project. Figure 13 shows that the current Ci-Dev portfolio – representing a portfolio of household energy access programs – is very much concentrated in countries with high political risk.

Figure 13: OECD Country Risk Classification for different country groups[38]



Counterparty risk (off-take risk)

Counterparty risk describes the risk that the CER off-taker is not willing or able to purchase credits. Under the current Ci-Dev set-up, there is basically no such risk since sovereigns with strong credit risk ratings guarantee off-take of a pre-defined CER volume. Only if Ci-Dev was cooperating with other (voluntary) off-setters, the creditworthiness of such cooperation partners and the impact on the (perceived) overall counterparty risk had to be assessed.

[37] https://www.miga.org/Documents/Glossary_of_Terms_Used_in_the_Political_Risk_Insurance_Industry.pdf

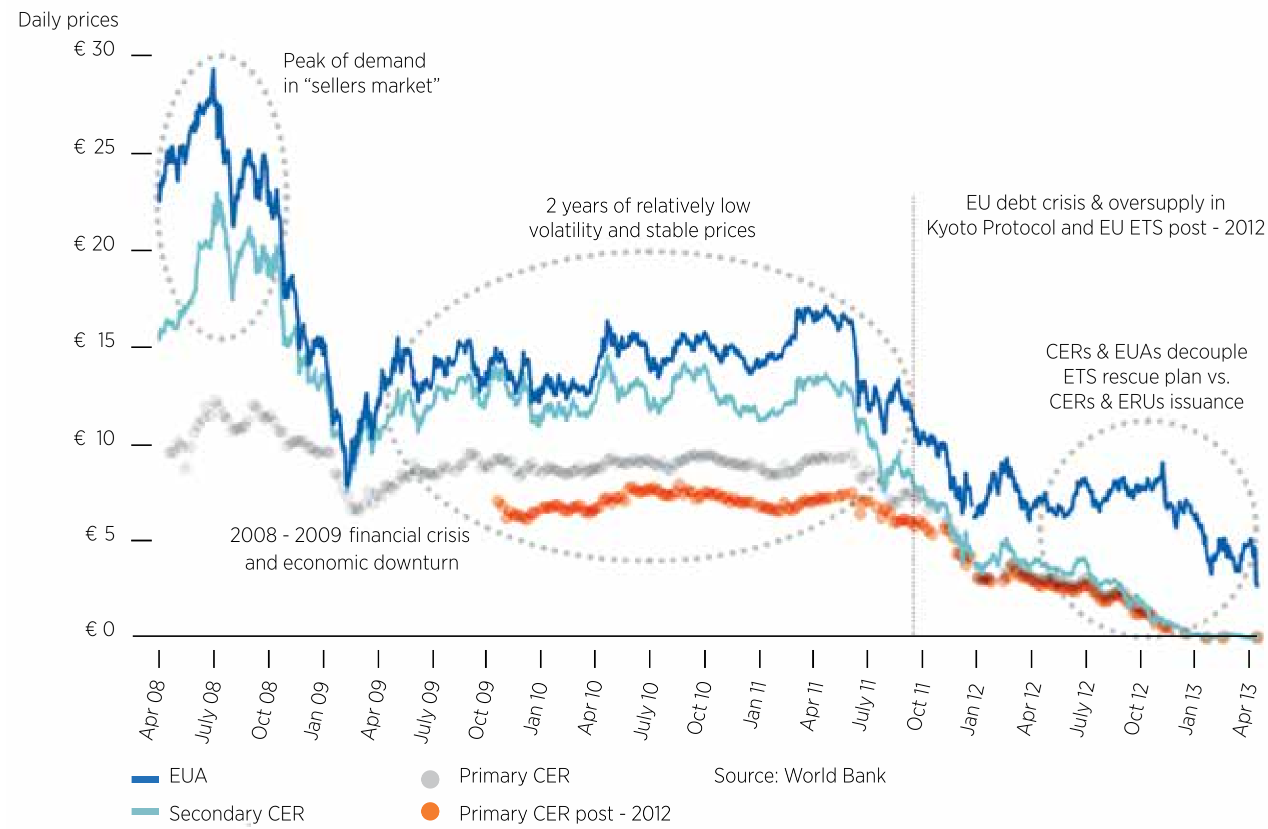
[38] Scale goes from 1 (lowest political risk) to 7 (highest political risk). Source: Own analysis based on OECD Country Risk [37] [37] [37] Classifications of the Participants to the Arrangement on Officially Supported Export Credits. For the World incl. OECD group, it has been assumed that 50 percent of the high income OECD countries would be assigned a classification of 1 and another 50 percent would be granted a classification of 2.

Price risk

Price risk is the risk that CER prices change (decrease) in the course of a CDM project. This might be particularly relevant for household energy access programs that are often planned to be rolled out over several years. Again, under the current Ci-Dev set-up, the World Bank guarantees off-take of a pre-defined CER volume at a pre-defined price – both agreed with the CME in the ERPAs. Therefore, there is currently no price risk for the Ci-Dev project developers. Still the aspect of price risk might become more relevant and of greater importance in the long-term if carbon markets would recover and a CER pre-financing instrument could consider a scale up of activities by blending Ci-Dev-backed ERPAs with market-based ERPAs. For market-based transactions, the risk of decreasing prices could then again increase the delivery risk as project implementers might lose their incentive to generate valueless CERs.

Historically, carbon prices have gone through relatively stable but also highly volatile periods (Figure 14).

Figure 14: EUA and CER prices[39]

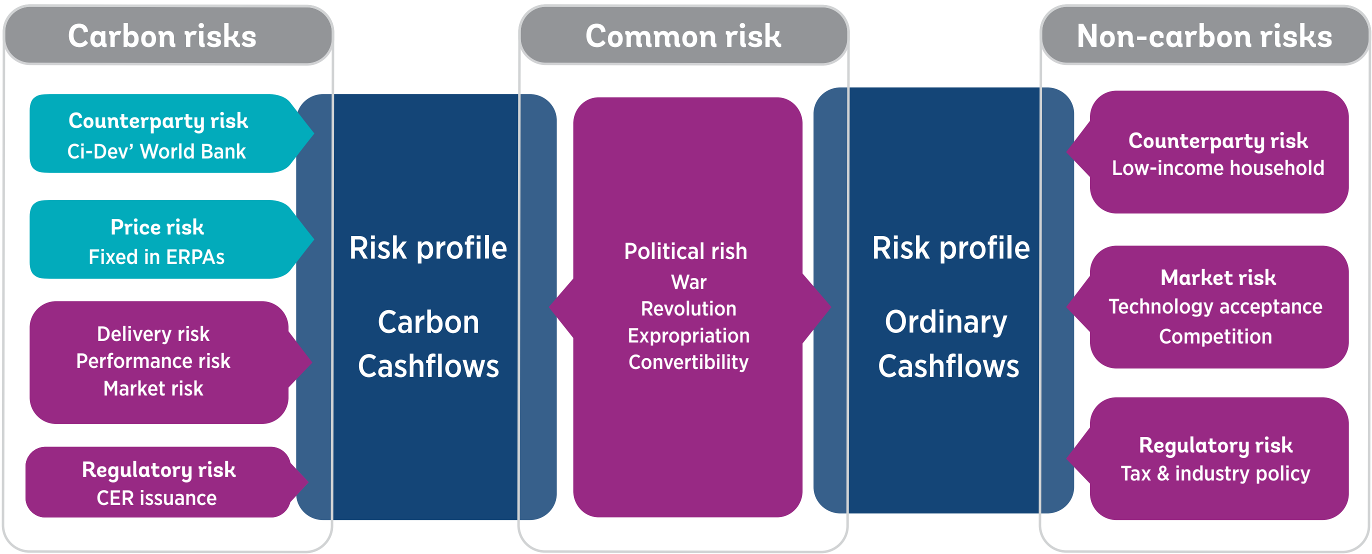


Carbon vs. non-carbon risks

Using the example of Ci-Dev, Figure 15 summarizes the risk profile of carbon cash flows from a project implementer's point-of-view, and compares it against the risks of ordinary (that is other non-carbon-related) cash flows. Green implies that risks do not exist and are neglectable, respectively; orange implies that a risk exists, but is yet manageable.

[39] Source: World Bank, Mapping Carbon Pricing Initiatives, Developments and Prospects, 2013

Figure 15: Risk profiles of carbon cash flows and ordinary cash flows



Carbon risks and non-carbon risks of CDM programs are also different from a financier's perspective, which justifies different financing instruments. On the one hand, while market risks are identical for carbon and non-carbon cash flows, CER delivery also depends on the actual performance (of low-carbon technologies), MRV, and CER issuance. On the other hand, under Ci-Dev, there are no counterparty (off-take) or price risks for selling CERs. Performance risk and counterparty risk can be relatively high for (pre-) financing non-carbon cash flows, for example if micro loans are offered for financing the low-carbon technology. Especially in LDCs, non-performing loan rates can be relatively high, and the institutional capacity of MFIs (as counterparty for the re-financing institution) can be relatively low. Altogether, the pre-financing of carbon cash flows is perhaps less risky and hence less costly than the pre-financing of ordinary cash flows.

Other risk considerations for CER pre-financing

To facilitate pre-financing of future CER revenues, there are three further aspects that have to be closely considered – all of which will impact the pre-finance instrument itself. Firstly, the introduction of pre-finance may actually increase the risk of CER delivery. Receiving revenues upfront could reduce the performance incentives on the part of CMEs and/or CPA Implementers, especially for household energy access programs for which carbon revenues account for the largest share. Especially private financiers take the incentive problem very seriously. For instance, when providing a high debt share to a project, commercial banks usually prefer a decent equity contribution to ensure the sponsor's/implementer's commitment (that is to avoid moral hazard). However, at least for commercially run projects, this "reduced incentive" risk is expected to be relatively low, as CER pre-finance is senior to equity, and dividends can only be paid once pre-finance is adequately repaid.

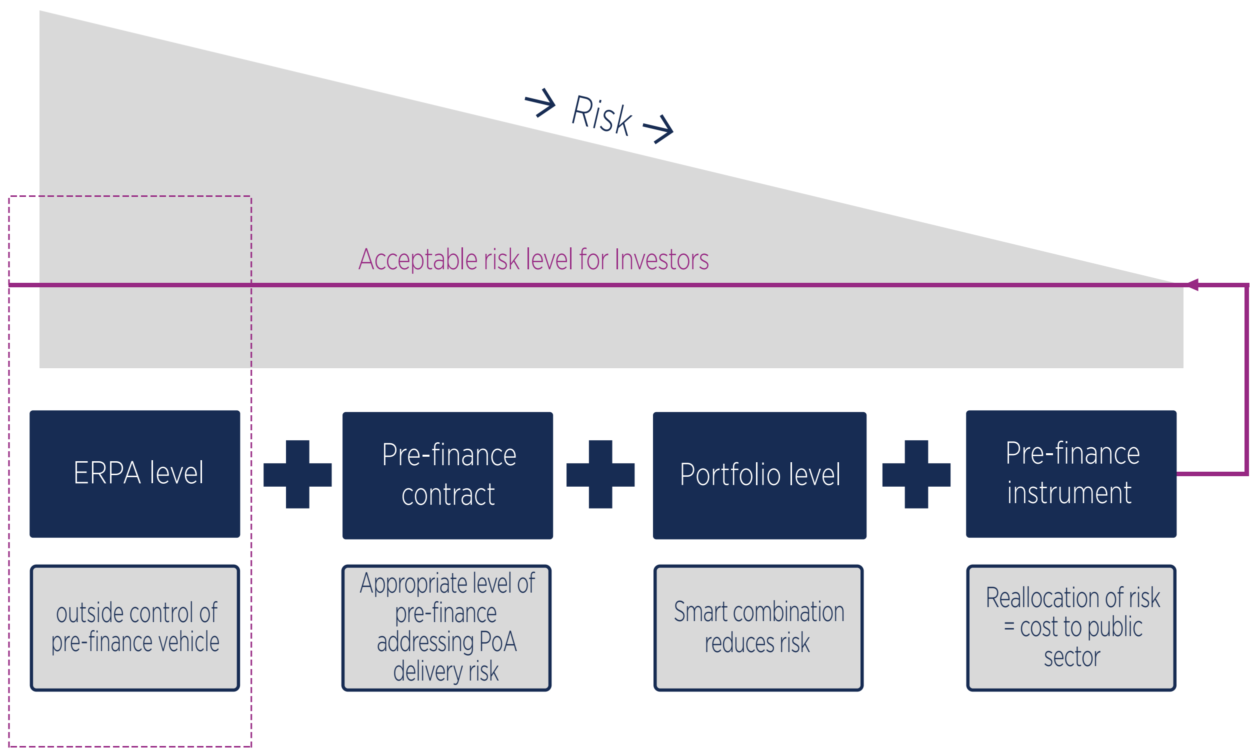
Second, in the case of a pre-finance fund, investors might face a blind-pool risk of investing in an unknown project portfolio (if pre-financing is not only provided to an already existing PoA portfolio, and if the fund should have a revolving character, respectively). Although investors are informed of the CDM process and the Ci-Dev eligibility criteria, they are not directly involved in project selection and the final decision making process of the Ci-Dev investment committee. Hence blind-pool funds require a high level of trust in the fund manager. This could be an issue, considering the relatively high CER delivery risk of certain household energy access programs in Africa, coupled with the aforementioned incentive risks associated with advance payments. Third, in the case that pre-financing is organized through a fund, there could be a ramp-up risk of underestimating the time for committed capital to be actually invested (that is before it can start generating returns for the fund investors).

2.3.2. Risk mitigation and allocation options

The two main objectives of risk mitigation and allocation at various risk levels are i) to reach an acceptable risk level for investors in the pre-finance vehicle, and ii) to ensure efficiency and thereby minimize financing costs. These objectives can be met in an efficient manner by addressing all risk levels in parallel as illustrated in Figure 16. Risk mitigation is most efficient at the ERPA level, pre-finance level and portfolio level. On the level of the actual pre-finance instrument, only risk allocation can take place.

Ultimately, the CER pre-finance instrument would only support CDM projects that have been pre-selected by a carbon finance initiative. Therefore the new vehicle relies on (and can build up on) previous risk assessments. Ci-Dev for example has a strong risk management practice in place – on individual ERPA level and portfolio level. The following section gives an overview of risk mitigation and allocation under the current Ci-Dev portfolio and adds aspects that should be considered for managing the pre-finance instrument.

Figure 16: Different levels of risk mitigation and allocation



ERPA level

As part of the selection and carbon pricing process, Ci-Dev assesses the different risks with a strong impetus on CER delivery. Besides, monitoring of CER delivery is an integrated part of Ci-Dev's project risk management. Although Ci-Dev's mandate supports relatively risky projects in LDCs, the relatively high CER delivery risk of some CDM project categories (as mentioned above especially for cookstoves) can be mitigated for individual ERPAs.

As a result of its risk assessment process, Ci-Dev mitigates delivery risk by applying a project-specific risk adjustment (that is contracting only a share of the forecasted CERs) and a combination of firm purchases ("Contract CERs") and options. Due to the reverse calculation of the CER price (based on the viability gap divided by the expected number of CERs generated) there might be limited incentive for Ci-Dev to assume high expected output. The goal seek on CER prices enables Ci-Dev to close the viability gap even below the respective program's assumed base-case growth of distributed systems and therefore the generated CERs. This conservative assumption regarding firm purchases (through reduced market risk) also reduces the risk for pre-financing. For the initial Ci-Dev portfolio, firm purchases mostly range from 40 to 70 percent of the expected total CER potential (~50 percent average).

According to the "ERPA General Conditions for programmatic CDM"[40], CER delivery failures are an event of default on the part of the CME. This document further states that the CME shall be fully responsible and strictly liable for sub-projects, and that the CME represents and warrants GHG reductions and CER delivery on program and sub-project (CPA) level. Usually there is no direct recourse to (or liability of) CPA Implementers in case of under-delivery.

However, CER delivery is of course in the interests of CPA Implementers as well. Carbon revenues are an additional revenue stream, perhaps making their operations viable in the first place. Besides, for the same reasons mentioned above for Ci-Dev (goal seek on CER price), CPA Implementers probably have little incentive to assume immoderate CER numbers. It is further possible that CPA Implementers have to compensate the CME for under-delivery by purchasing CERs of similar quality from the carbon market. Yet, especially if CPA Implementers benefitted from pre-financing of CER revenues, delivery risk could be allocated beyond the CME by allowing a further reaching (legal and financial) recourse to CPA Implementers. In other words, against current practice, recourse to CPA-level could further align interest and incentives with the CME, and in turn mitigate delivery risk for Ci-Dev and the pre-finance fund. Even though it is expected to be marginal for the household energy access programs in question, the additional delivery risk originating from pre-financing CER revenues (possible incentive problem) should be reflected in the pricing of the pre-finance fund.

Another "performance incentive" that contributes to delivery risk mitigation and allocation is the equity and debt components that almost all Ci-Dev projects (currently 10/12) have on the CME or CPA level. Additionally, two thirds of existing projects (8/12) include working capital loans. Either CME or CPA Implementers are responsible for raising – or, in the case of consumer finance – providing these funds. There is no consistent pattern which would allow for the clear identification of the three Ci-Dev business models[41] with compatible financing structure. It is always the CME and/or CPA Implementer and their financiers that take the upfront financing risk. In addition, in the case of non-performance, the CME may have some sunk costs for CDM program administration, meaning that the risk faced by CMEs is even higher.

[40] IBRD: General Conditions Applicable to Certified Emission Reduction Purchase Agreement; Programmatic Clean Development Mechanism Programs; July 2015

[41] See Carbon Limits A

Although risk exposure exists primarily at the level of the CME/CPAs, end-users are to some extent included in the results-based character of the project by non-financial incentives. In some projects, the Ci-Dev component finances performance-based maintenance subsidies and extended guarantees. These positively affect end-user behavior since they incentivize the consumers to increase usage of their products. Legal or financial recourse to end-users in case of CER under-delivery, however, seems not feasible.

Pre-financing level

Interests between the carbon fund and the CER pre-finance fund should be aligned, meaning that some risk mitigation measures at the ERPA level could be adopted at the point of pre-financing. At the ERPA level, Ci-Dev only contracts a share of forecasted CERs. As mentioned above, assumptions on expected CER volumes are usually not overly aggressive as Ci-Dev can close the viability gap by negotiating a project-specific CER price. An additional haircut for risk mitigation at pre-finance level (to further reduce contracted CERs) might not be necessary, provided that the managers of the pre-finance instrument have full access to the ERPA-level risk assessment. In other words, the due diligence of Ci-Dev (or any other cooperating carbon fund) has to be accessible and transparent regarding assumptions and reasoning for contracting (only) a certain share of forecasted CERs. There is the possibility that an additional haircut might even increase the risk that the program implementers cannot finance the targeted growth, thereby increasing the delivery risk over time.

The key instrument for risk mitigation on the pre-finance level will be a gradual contracting structure (as shown indicatively in the bottom left quadrants of Figure 6 and Figure 7). Pre-financing the entire ERPA volume at once would not only create unproductive cash buffers in the balance sheet of the program implementers (as discussed in the context of Figure 5). It would also imply an increased risk that funds are used for purposes other than immediate CER generation (for instance setting up of new offices for future market expansion; see again section 2.1). Over the program (ERPA) lifetime, it is not always entirely clear which funding source is used for which purpose, so that the pre-finance vehicle would be exposed to a higher extent to “non-carbon” risks. Limiting the pre-finance contracts to shorter periods would reduce the uncertainty regarding the actual application of funds, and enable the alignment of pre-finance volumes to easily predictable CER volumes (short-term targets).3 In terms of overall portfolio management, it will enable the fund manager to reflect on previous experiences (CER delivery) in new contracts, and, in the worst case scenario to withdraw from a project. Volumes and terms (including repayment profiles) have to be defined on an individual project-basis.

It is worth mentioning again that incentives are different under the current Ci-Dev structure and possible future market-based transactions. For the pre-financing of Ci-Dev projects, the CER price is determined with a goal seek – and then fixed – whereas CER volumes are estimated rather conservatively. In a (future) carbon market, significantly higher CER volumes can be traded, resulting in an additional price risk for the pre-finance instrument.. This price risk might need to be hedged. On the other hand, there could also be a positive climate mitigation/adaptation effect if the theoretically required carbon prices (currently paid by Ci-Dev) were achieved in the market.

Portfolio level

Similar to risks at an individual project level, many risks at the portfolio level are strongly aligned with and managed by Ci-Dev. Most importantly, Ci-Dev has already diversified its portfolio to a large extent in terms of target countries (nine for twelve projects, all in Africa) and energy access technologies (from presumably more risky cookstoves to biodigestors and several less risky solar products for rural electrification). Besides, funds like Ci-Dev typically invest in individual projects gradually, which allows both sufficient time for adequate due diligences and the gaining of experience before funding is fully committed.

A further investment and risk mitigation option for pre-financing carbon revenues could be diversification towards qualitatively different projects such as REDD plus. Compared to the current Ci-Dev portfolio, REDD plus projects have a considerably longer lifetime, and expected carbon savings are largely uncorrelated.

From the perspective of an investor in a pre-finance instrument, delivery risk will be a key driver of the overall risk profile. Depending on the project category, performance risk might be less of a concern than market risk. Household energy access programs often target relatively high growth rates for CER issuance, exposing the current Ci-Dev portfolio to a significant amount of market risk. Adding projects that target less growth and that finance assets with a longer lifetime might add stability to the portfolio and further benefit the portfolio diversifying.

Pre-finance instrument level

As indicated above in the context of program sustainability, long-term and reliable CER delivery not least depends on access to long-term (or revolving) finance. The mere access to the pre-finance instrument itself could contribute to mitigating the CER delivery risk.

However, at the instrument level, remaining project and portfolio risks cannot be mitigated actively. Instead, risks can be allocated between and among public and private investors, and perhaps insurers. Delivery risk can be addressed on two allocation levels: First-loss buffers can be applied for addressing the actual performance risk, whereas guarantees seem appropriate address the country risk. Both instruments can be used independently of the pre-finance structure.

[41] Ideally, from a risk management perspective, the pre-finance vehicle would only enter into transactions which have all other financing needs already covered. For reducing the CER delivery risk, projects that (still) lack finance for non-carbon cash flows could then not become part of the pre-finance portfolio. However, such restriction would probably prevent most projects from realization. The fund manager has to find the right balance between restrictive risk avoidance and enabling risk-taking.

Key messages:

- Household energy access programs aim to make low-carbon energy technologies accessible and affordable. Especially NGO- and PPP- implemented programs offer energy systems at low/no cost, and hardly generate any sales revenues. CERs are often the largest revenue stream.
- In the medium to long term, CER revenues can significantly contribute to the financial viability of household energy access programs. However, these future revenues often have to be pre-financed for initiating the programs in the first place.
- CERs should not be pre-financed over the entire ERPA duration. Pre-financing should rather be done in tranches, limited for instance to the lifetime of the energy systems. Besides mitigating risk, this would also result in a significantly lower required funding volume.
- The main risk of pre-financing CERs is the actual CER delivery, which in turn depends on project performance and local market conditions, as well as on CDM regulation and country-specific (political) matters. Performance risk and market risk can be quite significant for energy access programs, and vary largely across CDM categories (cook-stove programs are particularly risky). The regulatory risk of CDM registration and CER issuance is moderate to low.
- A pre-finance vehicle would for the time being only support CDM projects that have been pre-selected by Ci-Dev. Ci-Dev performs a thorough risk assessment as part of its project selection and carbon pricing process, contracting only a share of forecasted CERs, and diversifying its portfolio in terms of countries and technologies. While the political risk in Ci-Dev target countries (LDCs) is relatively high, there are no counterparty (off-take) and CER price risks.
- Access to a pre-finance instrument per se reduces the financing risk and perhaps the CER delivery risk. A gradual contracting structure can additionally mitigate the delivery risk at a pre-finance level. Short-term contracts, for example over the lifetime of the equipment, facilitate the alignment of pre-finance volumes to predictable CER targets, and allow the fund manager to design new tranches and contracts based on previous experience.

3. CER pre-finance instruments

As outlined above, pre-financing CER revenues could help making a CDM project bankable, and could contribute to the unlocking of a substantial project volume. The first part of this section argues that a donor-funded reimbursable grant facility is perhaps the easiest and quickest way for demonstrating the relevance and the feasibility of CER pre-finance in the Ci-Dev context.

Section 3.2 presents several concepts for upscaling CER pre-finance under private sector involvement. It discusses the suitability of different instruments for pre-financing a portfolio of household energy access programs, including the pros and cons from a cost-, risk-, and fund raising perspective. It goes without saying that the risks, costs and design features of each instrument depend on each respective (real) case, and that a generic overview can only broadly outline the key characteristics of (and main differences between) the selected options. Following on from the previous sections, each instrument must not be understood as a stand-alone vehicle, but rather as a supporting add-on for Ci-Dev or similar initiatives in order to pre-finance CER revenues.

In section 3.3, a decision tree guides the way to the most appropriate instrument, depending on some key determinants such as carbon market development, transaction costs, administrative considerations, and risk appetite. Again, it depends on each decision makers' individual agenda which path to pursue, and to decide if one of the instruments – or an adapted form of them – is a conceivable option at all.

3.1 Reimbursable grant facility

The pre-financing of CERs for household energy access programs is a new feature of RBCF that will require a test run before being commercialized. It is usually the public sector that demonstrates the feasibility of a new financing approach – of course aiming at crowding-in private investors at a later stage. Demonstration projects are usually initiated in a short lead time, and quickly create a track record at relatively low cost.

Since all potential Ci-Dev projects are in principle financially viable, using a reimbursable grant approach would allow for fast deployment of support while at the same time maintaining the efficiency of the intervention. A donor-funded reimbursable grant facility would step-wise disburse grants to CMEs for closing the (CER-related) pre-finance gap of a certain period. CMEs would then reimburse the grants after selling (results-based) CERs to Ci-Dev.

The following two structures could be used for implementation:

- Under a grant-to-loan structure (Figure 17), the facility would provide a conditional grant to the CME. In case the project is successful and able to produce sufficient CERs to pay back the grant, the conditional grant would convert into a loan and the CME would pay back the loan to the facility. In case the CME is not able to sell (enough) CERs to Ci-Dev, the conditional grant would convert into an unconditional grant and the CME would not have to reimburse the facility.

- Under a loan-to-grant structure (Figure 18), a loan would be granted to a CME, either by a dedicated loan window under the facility or by a commercial bank. In case not enough CERs are generated to pay back the loan, the dedicated grant window under the facility would assume the debt obligation and pay back the loan. In case commercial banks are involved, the grant window under the facility would issue a guarantee to the commercial bank which the bank could call in case of CME default.

Figure 17: Grant-to-loan structure

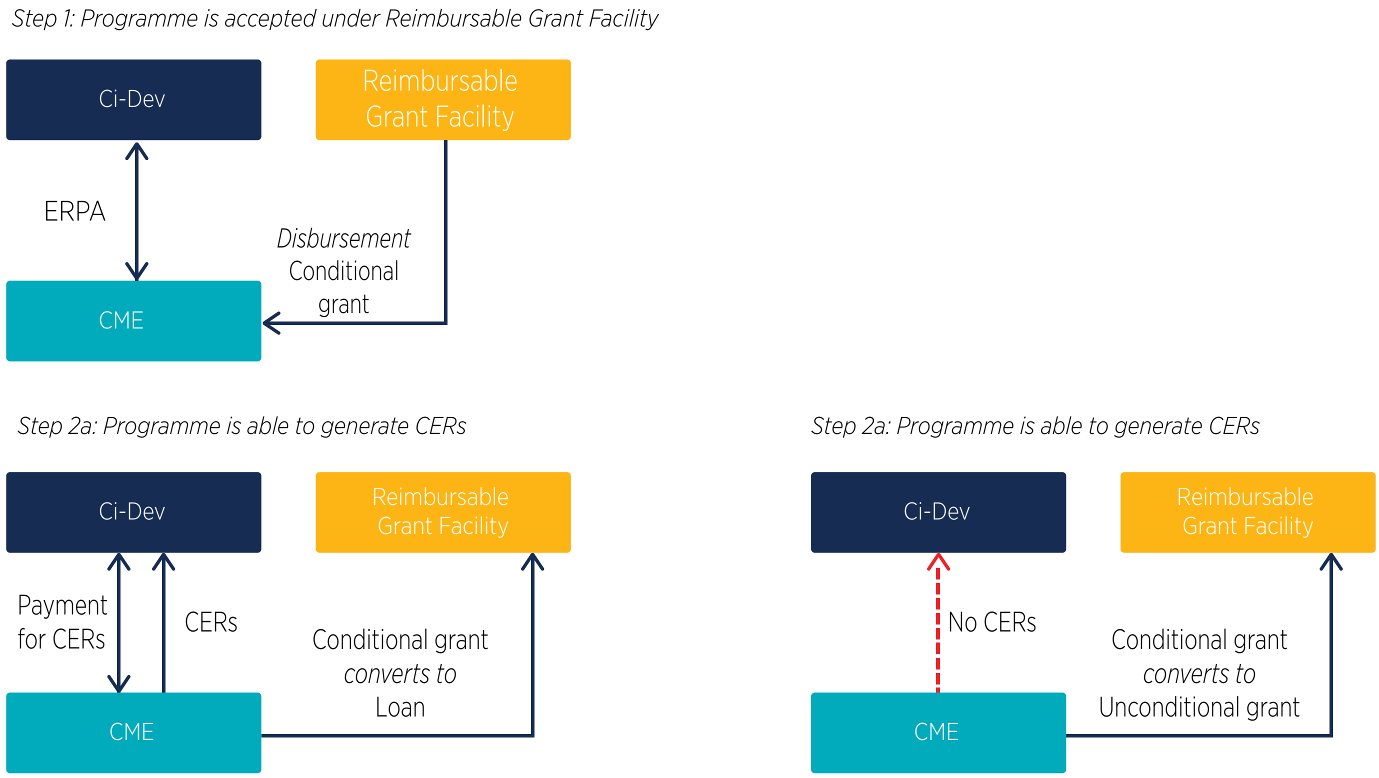
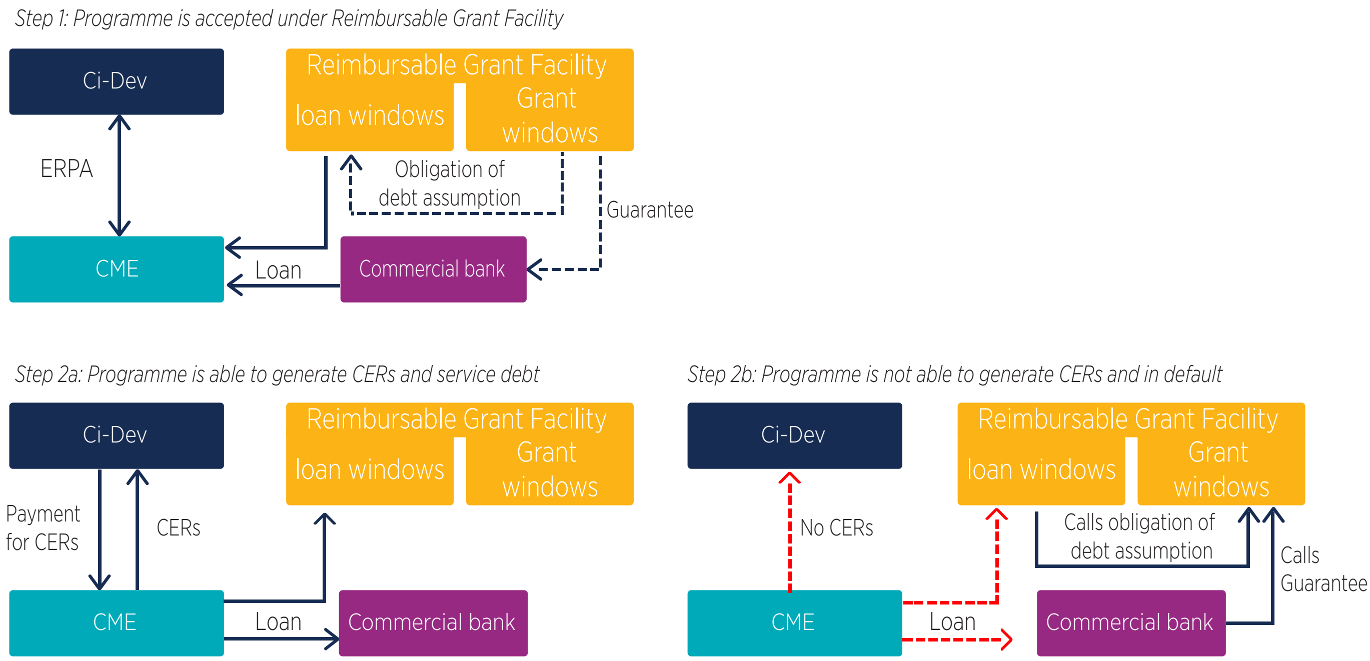


Figure 18: Loan-to-grant structure



The main justification to use a loan-to-grant structure as opposed to the grant-to-loan structure would be to crowd in the private sector and reduce the amount of public funds that would have to be deployed upfront. However, successful implementation of such a structure would strongly depend on the appetite of commercial banks to provide debt financing; the banks' willingness to participate in such a structure would have to be assessed first. A loan-to-grant structure, however, would be more complex and most likely entail higher transaction costs. Finally, the two structures would also have to be assessed with a view to assess tax and accounting implications for CMEs and the facility.

Due to its lower complexity, it is suggested to use a grant-to-loan for the pilot phase. Following the pilot phase, there are three options, depending on the performance of the pilot phase and the investors' appetite to invest into a commercial pre-finance structure:

- A commercial structure (see next section for more details on potential structures) in case there is investors' appetite;
- A loan-to-grant structure as an intermediate phase between the pilot phase and a commercial structure in case general interest exists but potential investors would like to gain more experience with pre-financing energy access projects;
- A permanent loan-to-grant structure if the investors' appetite to invest into a commercial pre-financing structure is limited, and if there is only low probability that this could change in the medium term.

While projects cannot be moved between a grant-to-loan and a loan-to-grant-structure, the facility could also alternate structures in different funding rounds, or run the two structures in parallel and differentiate by project type. As highlighted before, financial institutions' interest to participate in a loan-to-grant structure is essential for its success.

Whichever option is selected, successful demonstration of the pre-finance approach – that is of course mainly by a high reimbursement rate – would justify scaling the facility up and transforming it into a fund-type structure. Once a track record is established and the financial viability is demonstrated, private investors will start to complement and/or replace scarce public resources, thereby further leveraging the donor intervention.

3.2 Overview of pre-finance instruments with private sector involvement

Layered (revolving) fund

Layered funds enjoy a long-standing track record. In climate (and development) finance, layered funds often feature an asymmetric risk-return allocation between junior and senior tranches. Not least for attracting private investors, multiple donors (that is not only the initiating one) take the first loss for the lowest return; IFIs take second loss for medium return; private investors have the least risk for the highest return.

Yet, especially if setting up a completely new fund, transaction costs can be substantial. Initially the fund has to be set-up, registered, capitalized, and operationalized, before being managed in the medium- to long-term. Transaction costs are expected to decrease with the number of transactions; therefore a fund might make most sense if sufficient potential exists, that is if Ci-Dev targets a large number of ERPAs – and has acquired funding to do so.

Initial transaction costs could be lowered significantly if operating through an existing finance facility that has an existing management structure and an investor network. In this case, the strict and sometimes difficult separation of carbon and non-carbon cash flows might be less relevant. This option is, however, expected to come along with reduced competence (right to a say in decision making) and reduced visibility of Ci-Dev itself. Besides, existing investment guidelines of this facility might not correlate fully with those of Ci-Dev, making it difficult for the project to enter into both (CER off-take and pre-finance) contracts.

In any case, as investments only take place after financial commitment of the investors, such funds usually imply the fairly unpopular blind-pool risk for investors. Although investors know the purpose and eligibility criteria of Ci-Dev, they are not involved in project selection or the final investment decision making process. Hence blind-pool funds require a high level of trust in the fund manager. This might be an issue considering the relatively high CER delivery risk of household energy access programs, as well as the aforementioned incentive problems generally coming along with advance payments.

In the given context, the blind pool risk of private investors can be mitigated by starting operations with public money only. In that sense the fund would initially continue working like the donor-funded reimbursable grant facility. Public money could be used for building an initial project portfolio, that is for pre-financing the first tranches of projects.[43] Based on CER delivery and repayment rates, private funding could be raised later for financing follow-up tranches of successful projects. Strictly speaking this mitigation measure only works as long as no new projects are pre-financed after the private sector invested in the fund. Yet, over time, there will also be a learning process regarding overall project types, clusters and countries that will reduce the blind-pool risk itself. Besides, (private) investors could be involved in making investment decisions (however again increasing transaction costs). Another option is to consider other instruments like bonds and securitizations, both of which have gained increasing relevance in climate finance over the past decade.

Green bonds

The issuance of green corporate bonds could source funds for CER pre-finance. The "typical" green bond maturity of 3-6 years (in line with products offered for instance by World Bank or KfW) would fit the assumed payback period of pre-financed CERs on household level. In line with the majority of current green bonds, only the use of proceeds would be committed, with repayment depending on the issuer's balance sheet rather than ring-fenced cash flows generated by the financed assets. Green bonds for CER pre-finance could be issued at relatively low costs, assuming they are aligned to or coupled with other existing products of the issuing institution.

Another advantage – from an investor's point of view and contrary to an investment fund – is that coupon payments are usually independent in volume and timing from the CER issue success of the underlying assets (that is the low-carbon projects). The CER delivery risk remains fully with the carbon fund itself (and with other stakeholders of the energy access program, respectively), or will be (partly) transferred to the bond issuer. Hence blind-pool risk and also ramp-up risk are irrelevant.[44] Conversely, investors are assumed to be less committed to the carbon fund and its overall objectives.

[43] As discussed in the context of risk mitigation at pre-finance level, CERs should only be pre-financed gradually in consecutive tranches.

[44] The ramp-up risk describes the risk of underestimating the time until committed capital can actually be invested.

Securitization

The World Bank could further think of securitizing an existing ERPA pre-finance portfolio. On the one hand, an interim investor (for instance World Bank itself or another IFI) would have to provide funds for the pre-finance portfolio before it could be securitized. This so-called warehousing is required to bridge the time-lag between origination of the project portfolio and placement at the capital market. On the other hand, this option would as well bypass the blind-pool and ramp-up risks, making it more attractive for investors as the ERPA pre-finance portfolio is known in advance.

Table 5 compares the different instruments on the basis of five selected criteria: Matching repayment profiles of the financing instrument and the pre-financed CERs of a portfolio of household energy access programs (the maturity of a financing instrument can pre-determine the portfolio composition, and vice versa); transaction costs; instrument-specific risks, including mitigation and allocation options; and investors' commitment to and familiarity with the financing instrument.

Table 5: Assessment of different CER pre-finance instruments

CER pre-finance instrument	Brief description	Fit of repayment profiles [45]	Transaction costs	Risk mitigation and allocation [46]	Required commitment of sponsor/ initiator	Familiarity of investors
Set-up of a new (layered and revolving) fund	World Bank initiates the set-up of a new layered fund, possibly for public and private investors. ERPAs would be pre-financed after finance was raised for the fund. Investors' return related to the fund's investments (successful CER delivery).	Yes for household PoAs (3-5 years payback period for overall project and CER pre-finance); as revolving fund possibly also for other project types with longer (CER) payback periods.	Relatively high initial costs (e.g. legal set-up, fund-raising, and operationalization) and operational costs (e.g. fund management); decreasing marginal costs, especially if structured as revolving fund; only pays off in case of considerable scale up of carbon finance activities.	For layered fund, asymmetric risk-return allocation between donors, IFIs and private investors (i.e. donors with first loss and lowest return); risk buffers can be provided by multiple donors.	Layered fund structure allows for cooperation with multiple first loss investors. Third-party risk buffers possible.	Presumably high, particularly from donors and IFIs that have experience with (other) carbon finance instruments. Long-standing track record as appropriate instrument for attracting social impact investors
Blind-pool risk difficult to address	Layered fund structure allows for cooperation with multiple first loss investors. Third-party risk buffers possible.	See above.	Minimum as facility is already up and running.	See above, however, blind pool and ramp-up risk reduced.	Perhaps additional first loss contribution needed to convince fund management and existing investors to expand into ERPA pre-financing.	See above.
Green bonds	World Bank (or a cooperating IFI) emits green corporate bonds; funds are earmarked for pre-financing of ERPAs. Depending on the scale up potential as well as the targeted marketing effect, a dedicated green bond could be launched or the ERPA pre-financing could be added as potential use of proceeds in a broader green bond	Yes for household PoAs, assuming a 3-6 years bond maturity.	Expected relatively low costs for issuing.	No CER delivery risk for investors (remains fully with Ci-Dev, other program stakeholders, and/ or the bond issuer); coupon payments of corporate bond independent of project success; hence blind-pool and ramp-up risk irrelevant.	Credit enhancement provided by the issuing entity – integration of risk buffer by third party difficult.	High familiarity with green corporate bonds; bonds in any case seen as standard financing instrument.
Securitization	World Bank could securitize an existing ERPA pre-finance portfolio through a special-purpose vehicle (SPV). Unlike the other options, an interim investor has to provide funds for the pre-finance portfolio before it can be securitized (warehousing). Alternatively, an agent could be asked to provide warehousing and securitization. Time-lag between origination of project portfolio and placement at capital market.	Medium-term notes could match the payback period of pre-financed CERs for household PoAs (3-5 years); revolving transactions possible.	Medium, set up of an SPV necessary; in case of securitization by an agent asset management costs to be added.	No blind-pool and ramp-up risk as investors know Ci-Dev project pipeline at the time of the investment.	Third party risk buffers can be integrated as equity on SPV level, representing a first loss investment junior to private sector investments in securitized loans.	Relatively new instrument in climate finance, yet recently tested by BBOXX with Oikocredit (500,000 USD);

[45] Assuming that energy access projects amortize after 3-5 years (household PoAs); the payback period of pre-financed CERs is largely similar to the project payback period due to the large share of CER revenues in the overall revenue stream.

[46] Only includes risk mitigation and allocation options that are specific to the respective CER pre-finance instrument. General risk mitigation and allocation measures on ERPA-, pre-finance and portfolio levels that equally apply to all instruments are outlined in section 2.3.2.

3.3. Decision making map

In general, the selection of the most appropriate instrument for pre-financing ERPAs depends on several key decisions as illustrated in Figure 19. There are two fundamental questions: First and foremost, it has to be assessed whether a substantial scale-up of carbon finance – or more broadly, of RBCF – appears realistic. If so, this would put transaction costs into perspective and perhaps justify the selection of an initially more costly instrument. Secondly, the World Bank has to decide whether it is willing and able to provide and administer short-term (intermediate) pre-finance, and – if both is the case – to provide a risk buffer.

While the answer to the first question in the map ("do you believe in the future of carbon markets?") should be clear from a political point of view, it might still be worth having a look at the "no" path, which leads to a reduced but yet existing demand for CER pre-finance. In this case, the subordinate questions are whether Ci-Dev is expected to be scaled up beyond an already planned second round of fund-raising, whether it is intended to cooperate with other carbon buyers, and whether this cooperation would significantly impact the size and risk of the pre-finance instrument.

Provided the successful demonstration of CER pre-finance, the World Bank might want to opt for integrating or transforming the reimbursable grant facility into a new layered fund based on the following assumptions and expectations: Firstly, carbon markets are expected to recover, and/or initiatives like Ci-Dev can be scaled up in the medium term. Both developments would put the presumably high transaction costs of the new fund into perspective. Secondly, the World Bank cannot administer and/or provide intermediate pre-finance itself. Given a certain scale, a new dedicated fund could be more efficient in taking over both tasks. Thirdly, even if the World Bank is willing and able to administer and provide intermediate pre-finance, it might not be willing to provide risk buffers. The inclusion of third-party first-loss contributions appears reasonable if carbon finance becomes more mainstream. In a layered fund structure it is usually governments that provide the junior shares.

If World Bank prefers an in-house administration and risk buffer provision at instrument-level (despite the broader scale-up expected), it could also be in a position to issue a dedicated green bond only for a portfolio of household energy access programs. Providing CER pre-finance from a green bond that does not exclusively target household energy access programs could make sense if it is expected that there will be a long lead time for scaling up Ci-Dev substantially beyond the second tranche.

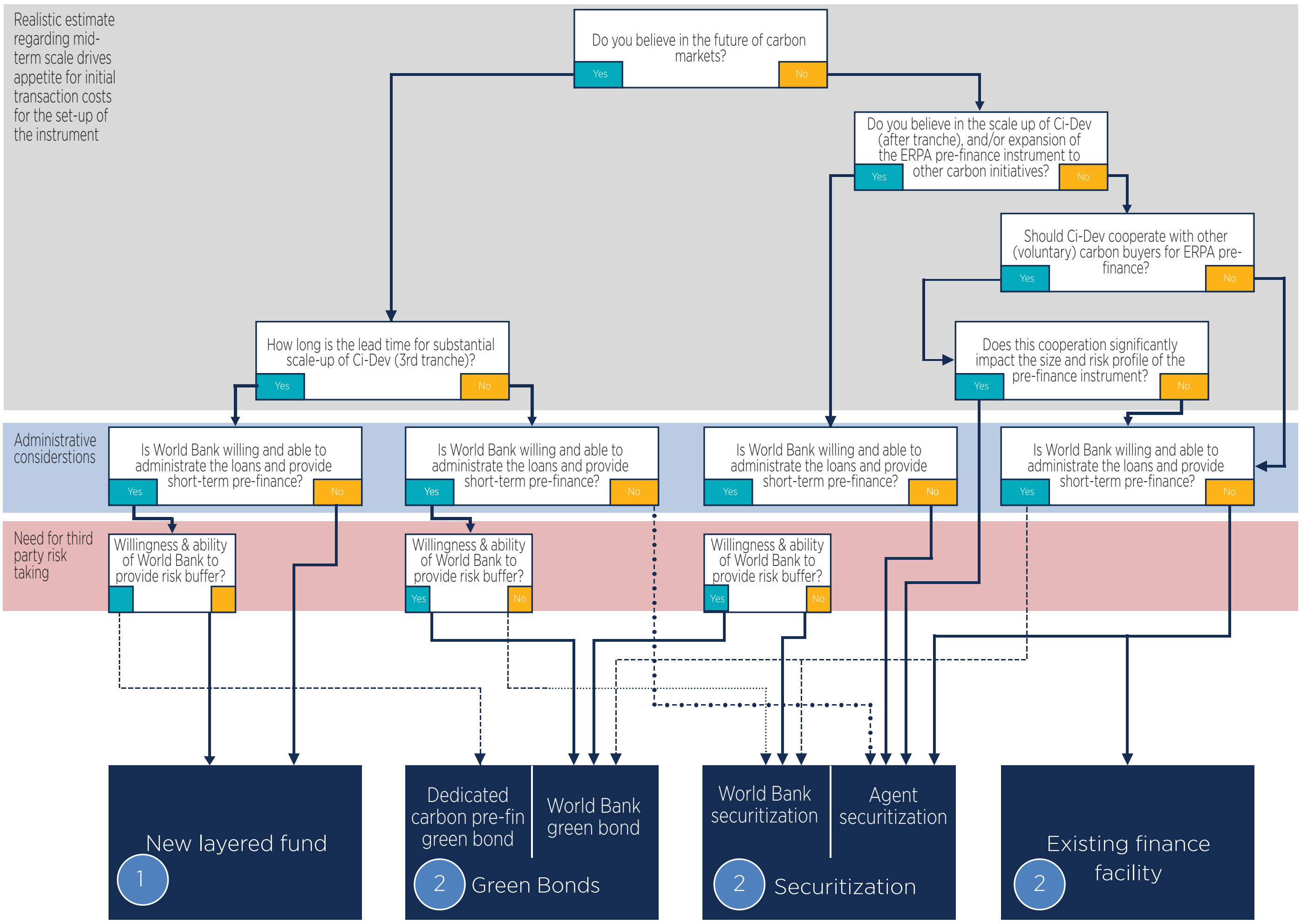
The World Bank could issue a securitized pre-finance portfolio itself if it i) believes in a certain market scale, but expects the preparation of a future tranche/portfolio to take relatively long; and ii) is willing and able to administer and provide intermediate pre-finance, but not to provide a risk buffer (in this case a third party would have to take the first loss). Securitization by another agent than the World Bank in principle makes sense if the same market scale and lead time are expected, but if the Bank does not want to administer and pre-finance itself.

The fourth option, which is operating via an already existing finance facility (fund), should be considered particularly if the funding of a Ci-Dev scale-up is still to be committed.

Key messages:

- CER pre-finance should first be demonstrated by means of a donor-funded reimbursable grant facility. This facility could be implemented either by a grant-to-loan or a loan-to-grant structure.
- Upon successful demonstration, the facility could be scaled up – most importantly by attracting private investors – and transformed into a new instrument.
- The selection of the new instrument (that is for instance a layered fund, green bonds, or securitization) will depend on the expected pre-finance volume (justifying transaction costs) and on the willingness and ability of the World Bank to administer and provide interim pre-finance.

Figure 19: Decision making map for selection of most appropriate pre-finance instrument



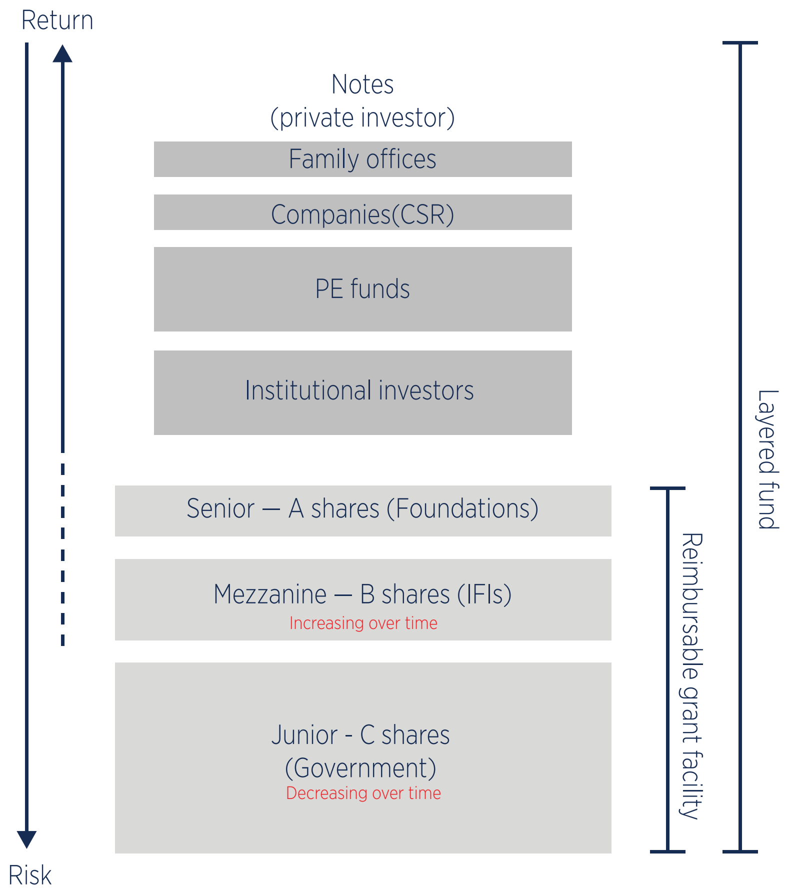
4. Fund mobilization

Different pre-finance instruments are capitalized by a different mix of investors. A reimbursable grant facility that is used for piloting and demonstrating a new approach like pre-financing of CERs is typically funded by donors (national governments and IFIs). Perhaps donor funds can be leveraged by money from foundations that are committed to fighting climate change and/or promoting clean energy access.

For scaling up and eventually for commercializing CER pre-finance, the grant facility has to be transformed or integrated into another instrument that at the same time has to address a broader range of investor classes – including the private sector. It can be expected that, at least initially, the instrument would primarily attract private investors that, besides financial return, measure their performance also in terms of positive social and environmental impact (so-called triple-bottom-line investors). These investors could be certain types of family offices, private equity (PE) funds, institutional investors, and companies with corporate social responsibility (CSR) strategies.

Different investor classes have different risk-taking profiles, return-expectations, and amounts to invest. Figure 20 illustrates a possible risk-return allocation and an indicative proportion of investment sizes (shown by the size of the grey boxes) for the reimbursable grant facility and a layered fund.

Figure 20: Risk-return allocation and indicative proportions of investment sizes



Layered climate funds often feature an asymmetric risk-return allocation between junior and senior tranches. This structure could already be applied for the reimbursable grant facility. Governments could provide the first-loss piece; IFIs could provide funds at medium risk; foundations could add senior shares for the least risk. Initially, governments are expected to provide the bulk of funds (decreasing over time as IFI funding increases), and none of the investors would be paid a return.

A return would have to be offered when turning the grant facility into a public-private fund. In this case it might also be appropriate (and applicable) to extend dividend payments to foundations and IFIs. In the long run, provided that carbon finance initiatives can be scaled up significantly (or the carbon market recovers), the amount invested by the private sector might exceed the amount invested by donors and foundations.

It is important to note that the asymmetric risk-return allocation in Figure 20 only applies at the fund level. Notes to the private sector are characterized by the lowest risk and the highest return. However, this asymmetric allocation does not necessarily apply within the private investor class. For example, while a triple-bottom-line PE fund might be willing to take relatively high risk for relatively low return, more commercially oriented PE funds or companies (even if part of their CSR strategy) might only invest if taking risks results in appropriate returns.

Annex 1: Assumptions and data sources for a portfolio of household energy access programs

Assumptions energy solutions at household level – program costs: Example of 9,000 biodigestors

The assumptions for this business model are mainly based on publicly available data for the CDM-PoA “West Africa Biodigestor Program”:

Parameter	Unit	Value	Source
Carbon price	USD/CER	10	Higher end of stated Ci-Dev range of 4 to 10 USD
Cost of maintenance	USD/unit/year	15	KfW. 2010. PoA Blueprint Book, p.81
Monitoring and Admin	USD/year	80,000	KfW. 2010. PoA Blueprint Book, p.82
Emission reductions	CER/unit/year	3.6	UNFCCC. 2016. ER_Sheet West Africa Biodigestor Program [Excel sheet]
Operational share	percent	0.9	UNFCCC. 2016. ER_Sheet West Africa Biodigestor Program [Excel sheet]
Cost of training	USD/unit	15	KfW. 2010. PoA Blueprint Book, p.81

The following table lists data on deployment and emission reductions from similar projects:

Project	Year 1	Year 2	Year 3	Year 4	Total	CwwER/ unit	Source
West Africa Biodigestor Programme	**2,0000**	**3,000**	**3,500**	**0**	**9,000**	3.6	UNFCCC. 2016. ER_Sheet West Africa Biodigestor Program [Excel sheet]
Biogas Programme Nicaragua (PBN)	300	700	1,250	0	2,250	5.6	UNFCCC. 2016. ER_Sheet Biogas Programme Nicaragua (PBN) [Excel sheet]
Vietnam National Biogas Programme	N/A				10,518	2.7	UNFCCC. 2016. ER_Sheet Vietnam National Biogas Programme [Excel sheet]
Pakistan Domestic Biogas Programme	500	2,500	6,000	9,000	18,000	2.8	UNFCCC. 2016. ER_Sheet Pakistan Domestic Biogas Programme [Excel sheet]

Assumptions energy solutions at household level – program costs: Example of 9,000 biodigestors

The assumptions for this business model are mainly based on publicly available data for the CDM-PoA "West Africa Biodigestor Program":

Parameter	Unit	Value	Source
Carbon price	USD/CER	6	Lower end of stated Ci-Dev range of 4 to 10 USD
System cost of stove	USD/unit	30	75% of retail price of model (EzyStove) mentioned in Ci-Dev documentation
Sales price of stove	USD/unit	10	Assumption based on similar programs. See below.
Emission reductions	CER/unit/year	2.5	Lower range value in Ci-Dev documentation
Monitoring cost	USD/year	40,000	KfW. 2010. PoA Blueprint Book, p.68
Set-up costs	USD	200,000	

The following table lists data on deployment and emission reductions from similar projects:

Project	Year 1	Year 2	Year 3	Total	Cost (USD)		CERs/unit/year	Source
					Sales price	System cost		
Sudan Cookstoves	**5,000**	**10,000**	**15,00**	**30,000**	10	35	2.5	
Efficient Cook Stove Rwanda PoA				24,152	2	37	1.85–2.15	UNFCCC. 2016. Rwanda Cook stoves ER_Sheet [Excel sheet] & PoA-DD p.15
Efficient Cook Stove Kenya PoA				29,672	0	~22		UNFCCC. 2016. Kenya Cook stoves ER_Sheet [Excel sheet] & PoA-DD p.11
Save80 Wing Model						17 - 47		Cleancookstoves .org data sheet
Philips HD4008						31		Cleancookstoves .org data sheet
Greenway Smart Stove						20-50		Cleancookstoves .org data sheet
ZaMa-Zama Wood Stove						~18		Rocketworks .org [wholesale price]

Assumptions portfolio of small RE plants: 5 x 5MW hydropower plants

Parameter	Unit	Value	Source
Carbon price	USD/CER	8	Middle range of stated Ci-Dev range of USD 4 to USD 10
CAPEX	USD/kW	3,700	Weighted average for small hydropower plants in Africa (according to IRENA Renewable Power Generation Costs 2014 p. 118)
Grid Emission Factor	CER/MWh	0.7	Conservative estimate (UNFCCC approved grid emission factor for the SAPP is 0.98)
Capacity Factor	percent	58	Weighted average for small hydropower plants in Africa (according to IRENA Renewable Power Generation Costs 2014 p. 119)
OPEX	USD/kW	60	Estimate based on IRENA Renewable Power Generation Costs 2014, p. 120
Plant size	MW	5	
FiT	USD/MWh	80	REFiTs in Uganda, Kenya and Ghana range between 82 and 115 USD/MWh.

The following registered small-scale CDM-PoAs have a similar structure:

Small-scale Hydro PoA Sri Lanka		Hydro Alliance PoA Guatemala		Masca Small Hydro Programme		NuPlanet Small Scale Hydro PoA	
Avg. plant size	# of plants	Avg. plant size	# of plants	Avg. plant size	# of plants	Avg. plant size	# of plants
2.2 MW	5	2.4 MW	3	3.0 MW	4	6.8 MW	3

Assumptions project finance – 40MW wind farm

Parameter	Unit	Value	Source
Carbon price	USD/CER	6	Lower end of stated Ci-Dev range of USD 4 to USD 10
CAPEX	USD/kW	2,000	Estimate based on recent studies. See below.
Grid Emission Factor	CER/MWh	0.7	Conservative estimate (UNFCCC approved grid emission factor for the SAPP is 0.98)
Capacity Factor	percent	30	Estimate based on recent studies. See below.
OPEX	USD/kW	40	Estimate based on recent studies. See below.
Plant size	MW	40	
FiT	USD/MWh	100	REFiTs in Uganda, Kenya and Ghana range between 60 and 160 USD/MWh.

The following table lists technology costs for wind as found in two studies with recent data:

Source	CAPEX (USD/kW)		OPEX (USD/kW)		Capacity Factor (%)	
	Low	High	Low	High	Low	High
Lazard. 2015. Lazard's Levelized cost of energy analysis - Version 9.0	1,250	1,700	35	40	30	55
IRENA. 2014. IRENA Renewable Power Generation Costs 2014 [estimates for Africa]	1,500	3,000	30		20	45

Annex 2: Assumptions and data sources for projected yearly CER volumes

Project / CERs generated per year	1	2	3	4	5	6	7	8	9	10	UNFCCC Ref #	Data Source
CookClean Ghana Limited - CPA01	2,616	47,025	151,510	151,721	151,721	151,721	151,721	151,721			8438	UNFCCC
CookClean Ghana Limited - CPA02				11,843	56,508	101,173	145,837	178,659	178,659	178,659	8438	UNFCCC
CookClean Ghana Limited - Total	2,616	47,025	151,510	163,564	208,228	252,893	297,558	330,380	178,659	178,659	8438	
West Africa Biodigestor Programme	4,070	13,025	23,608	29,307	29,307	29,307	29,307				9977	UNFCCC
Biogas Programme Nicaragua (PBN)	1,676	7,261	19,829	32,397	44,965	57,532	70,100				6813	UNFCCC
Pakistan Domestic Biogas Programme	646	4,524	15,510	34,898	46,530	46,530	46,530				8024	UNFCCC

Annex 3: Assumptions and calculation for pre-finance volumes

Year	1	2	3	4	5	6	7	8	9	10	11
Annual CERs bought by Ci-Dev under ERPAs (#)	137,216	340,870	631,612	803,303	1,067,466	1,481,177	1,542,157	1,659,252	1,743,332	1,594,972	808,502
Accumulated CERs bought by Ci-Dev under ERPAs (#)	137,216	478,086	1,109,698	1,913,001	2,980,467	4,461,644	6,003,801	7,663,053	9,406,385	11,001,357	11,809,859
Yearly Ci-Dev cash outflow (USDm)	1.4	3.4	6.3	8.0	10.7	14.8	15.4	16.6	17.4	15.9	8.1
Low risk pre-finance volume (USDm)	16.0	18.3	28.7	41.1	50.2	**55.8**	54.7	51.6	41.5	25.0	8.1
Assumed CER price	10 USD/ ton										8024
Weighted average of equipment lifetime	4 years										

www.ci-dev.org