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The World Bank's role in leveraging finance for climate change mitigation

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Abstract

This article addresses the question of how long- term financial resources can be leveraged for World Bank carbon offset projects. The focus here is on projects implemented under the CDM mechanism, which allows for the internalisation of the projects' external benefits related to the CO2 emission reductions achieved by the project compared to a baseline scenario. Under the CDM, an additional revenue stream is provided for those projects achieving "additional" emission reductions. These revenues can have a positive impact on the financial attractiveness of the project. It can be shown that the efficient sharing of the revenues (the carbon rent) can attract additional financial partners.

However, the provision of financial carbon revenues and the rent sharing is often not enough to attract financiers to developing countries due to pervasive barriers and financial risks. Thus, the World Bank has played an important role in the development of financial and contractual arrangements that allow risk sharing among the project partners. The financing structure of any project will be tailored to take into account the desire for rent and risk sharing between the different project partners. The question therefore arises as to who the partners of the World Bank for the financing of these projects are, and, what factors (country, project type, amount of carbon rent) impact upon their financing decisions.

The empirical analysis presented in this paper shows that the most important financiers of World Bank carbon offset projects in developing countries are local public institutions and multilateral and bilateral banks, that is, those institutions capable of assuming a higher degree of risk. These institutions seem to support those projects especially in low income countries and in situations where they receive relatively little carbon revenues compared to the overall investment costs. This indicates that, in development finance, carbon revenues are supplementary to public development finance. Also, for economic infrastructure, higher equity investments (as a percentage of investment costs) by the project promoter usually seem to be accompanied by higher carbon revenues (as a percentage of investment costs).

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1 Introduction

According to the World Development Report 2010, development goals are threatened by climate change, with the heaviest impacts to fall on the poorest countries and the poorer people in those countries. The development and use of low CO2-emitting technology to mitigate climate change is a predominant goal of international organisations and multilateral banks, such as the World Bank.

Investments in the development and modernization of infrastructure will play an important role in this context, as infrastructure investment is not only regarded as an important driver of economic development of poor countries, but also has significant potential for CO2 emission reduction.

In the Copenhagen accord issued after the international climate change negotiations in December 2009, commitments were made by the parties to provide funds "approaching" 30 billion USD between 2010 and 2012 and 100 billion per year by 2020. An important share of these sums is expected to be spent on infrastructure. The funding is expected to come from diverse sources, such as national, bilateral, multilateral and private financiers. This paper argues that it will be crucial to attract long-term financing for infrastructure, since these assets pay off in the long term and risks and benefits related to climate change also materialize in the long term.

The aim of this paper is to analyse the role of the Clean Development Mechanism (CDM) for the internalisation of the positive external benefits related to the CO2 emissions reductions and the role of the World Bank in the setup of the financial engineering of these projects.

In the theoretical part (chapter 2), development and climate change externalities that infrastructure projects produce will be analysed and it will be shown how these externalities are intertwined. The subsequent chapter 3 deals with climate change regulation put in place to internalise these externalities - especially the CDM, a financial mechanism designed to internalise climate change externalities and to capture the carbon rent created by the Kyoto Protocol by providing financial revenues for low CO2-emitting projects in developing countries. It is shown that it is not the provision of the carbon revenues on its own, but the efficient sharing of the carbon rent between the different project partners that can create incentives for the implementation and financing of these projects. However, in many cases, especially in developing countries, institutional barriers prevent investment and thus rents are not shared efficiently.

In order to lower these barriers, the World Bank Carbon Finance Unit (CFU) has developed different measures of financial engineering that take into account not only the carbon rent sharing but also the risk sharing between the different financiers. At the same time, the CFU has helped to prepare the market for investment in certified emission reduction credits of CDM projects to increase the diversity of financial products that capture investment in CDM projects. This two-fold role of the World Bank will be analysed in chapter 4.

In the empirical part (chapter 5) of this article the actual financial structures of historic World Bank carbon offset projects are described and it is analysed whether the financial structures vary between countries with different national incomes and between different project types and the amount of carbon finance provided in order to identify determinants of the financiers' decision making.

2 Development and climate change externalities of economic and social infrastructure investment

2.1 Infrastructure investment and economic externalities

In this article we use the most common definition of infrastructure (among others O'Fallon, 2003, Kessides, 1997). The term "infrastructure" describes the services provided by the physical networks or "infrastructure systems" associated with energy (gas, thermal, and water-based), water supply, transport, telecommunications, sanitation and waste facilities, and flood protection and drainage.

In economic theory infrastructure investment has only rather recently been regarded as a driver of long-term economic growth. In neoclassical growth models (notably Solow, 1956), the long-run rate of growth is still determined exogenously (i.e. outside the model) and the relationship between long-run growth and available policy instruments (such as public infrastructure expenditure) is not discussed in these models. Only the development of endogenous models has provided a framework for understanding the role of government activity, both on the expenditure and revenue sides (Bernard & Garcia, 1997). The work of Aschauer (1989) is considered to have been especially path-breaking. The author analyses the relationship between aggregate productivity and stock and flow government-spending variables and finds that a 'core' infrastructure of streets, highways, airports, mass transit, sewers, water systems, etc. can explain economic productivity.

Estache (2006) reminds that how much infrastructure spending really matters is an empirical matter, and that infrastructure matters more in low-income countries or in low-income regions than in richer countries.

Besides these macroeconomic studies, microeconomic literature has contributed to the quantification of development effects of infrastructure projects (see Kessides, 1997, for an overview)[2].

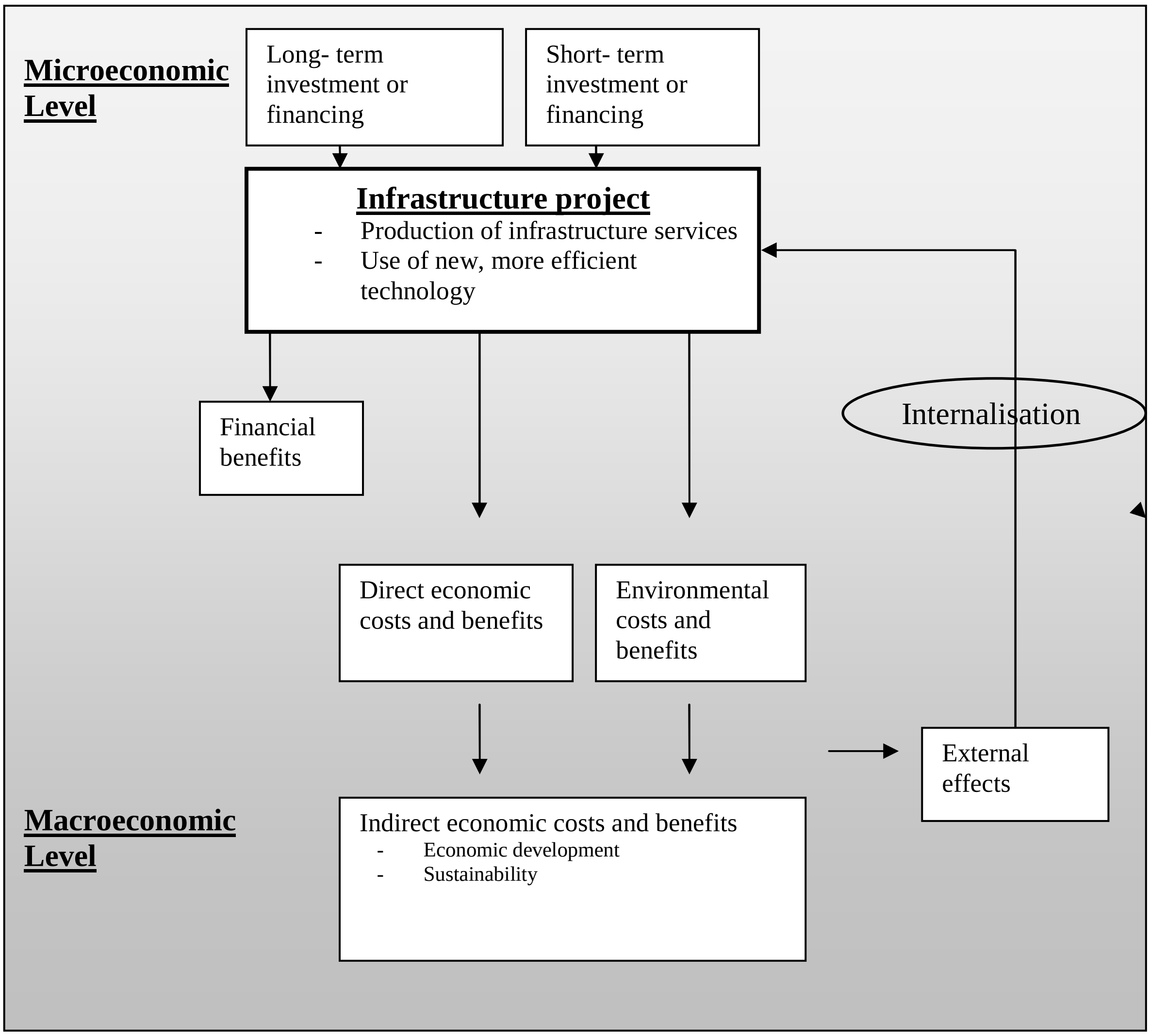
When discussing from a microeconomic perspective the channels through which infrastructure investment can drive economic development, it is important to distinguish between two different types of infrastructure – economic and social infrastructure. Economic infrastructure contributes to the

[2] Attention has to be drawn to the fact that a macro- and microeconomic analysis do not necessarily lead to the same results. Aggregate empirical results suggest much higher return to public capital than suggested by cost-benefit analysis of individual projects (Fox, 2007).

economic activity of a region. This category comprises transport networks (railway networks, roads, toll roads, airports, bridges, ports, etc.), communication networks and certain urban services (water supply, energy production and distribution networks). Social infrastructure is designed to meet the basic needs of the inhabitants of a region and includes facilities dedicated to education, health (water and waste treatment, hospitals), housing, security (prisons, military and police centres) and cultural and leisure activities (parks, etc.) (Holm, 2010).

Figure 1 pictures the linkages between macro- and microeconomic levels in this context. The investment decision for an infrastructure project is taken on the microeconomic level (where project promoters compete for financial returns and investment).

Figure 1 - Micro- and macro- economic benefits of investment in infrastructure



Nevertheless, projects have direct and indirect effects for the whole society and an impact on the macroeconomic development of a country. These direct and indirect effects are referred to in economic literature as externalities. The concept of externalities was introduced at the end of the 19th century to characterize the differences between private interest and public interest (Sidgwick, 1887) was further developed in the early thirties by Viner (1931). The term "externality" describes a side effect caused by an economic activity that is not taken into account in decisions by economic actors. Externalities have an impact on welfare (economic and health) of human beings. The predominant characteristic of externalities is that they are created without the intention of those who control the original activity and cannot be controlled by those who are positively or negatively affected. In other words, externalities arise when individuals are not obliged to pay for all the consequences of their economic activities (Keppler, 2008).

Externalities are usually related to the use of a public good. Economic development or the natural environment is such a public good. A public good is subject of collective consumption and has two characteristics: non-rivalry in use and non-exclusion from use. For our particular case this means that an infrastructure project can create benefits that the whole society benefits from for free without remunerating the original investor for the provision of this public good. Examples are efficiency improvements and consequently tariff decreases and an increase in the consumer surplus. Indirect economic benefits can be due to structural impacts as infrastructure contributes to the diversification of the economy by facilitating growth of alternative employment and consumption possibilities. Infrastructure services raise the productivity of other factors by permitting the transition from manual to electrical machinery, reducing workers' commuting time, and improving information flows through electronic data exchange. Infrastructure is often described as an "unpaid factor of production", since its availability leads to higher returns obtainable for other capital and labour (Kessides, 1997).

Social infrastructure can constitute in itself a public good, which often leads to different financing arrangements as we will see further down. The economic benefits related to social infrastructure are especially related to the improvement of the quality of life of the population.

Figure 2 provides concrete examples for direct and indirect economic benefits and costs of economic and social infrastructure.

Figure 2: Economic benefits and costs of economic and social infrastructure

	Examples	Remuneration of initial investor	Direct economic costs and benefits	Examples	Indirect economic costs and benefits	Examples
Economic Infrastructure	Transport, Energy and community services (utilities), communications	Through user charges	**<u>Benefits</u>:** Improvement of mobility, provision of energy	Connection of additional households to public transport, improved energy supply for companies	**<u>Benefits</u>:** Higher productivity of other economic sectors	Time savings for travel to work, cheaper use of electricity in production process
			<u>Costs</u>: negative environmental impacts	Air pollution through electricity generation by use of fossil fuels	**<u>Costs</u>:** degradation of productive resources	Agricultural production can be negatively affected by pollution
Social Infrastructure	Health care, waste, water, housing	Through public subsidies and if so low user charges	**<u>Benefits</u>:** health benefits, environmental benefits	Improved personal health due to cleaner water, soil and air	**<u>Benefits</u>:** Higher economic returns to labour	Improved health conditions of factory workers
					<u>Costs:</u> Economic opportunity costs of capital	Money spent on sophisticated waste collection cannot be spent on productive purposes

Environmental costs and benefits have been increasingly regarded as important as well for the assessment of the impact on projects on the overall welfare of a society (OECD, 1994; Pearce et al., 2006). In the following chapter we focus on environmental costs and benefits related to climate change.

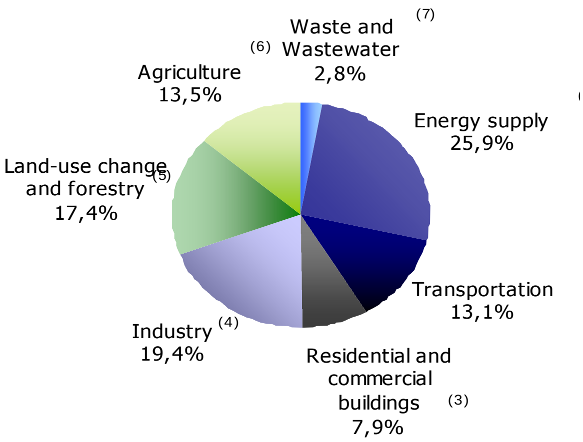
2.2 Infrastructure investment and climate change externalities

Over the last 20 years climate change has become increasingly important on the political agenda and in economic literature. There has been increasing consensus that infrastructure has a role to play in this context (Stern, 2007; IPCC, 2007). The Kyoto protocol that entered into force in 2005 has put in place project-based mechanisms to incentivise project partners to internalise climate change related externalities in their investment rationale. In the following the nature of these climate change related externalities will be discussed before the repercussions for investors are presented in chapter 2.3.

By emitting greenhouse gases (GHG) infrastructure projects produce a global externality. GHG externalities are usually referred to as "diffuse externalities" as it is impossible or very difficult to identify the pollution source or point of receipt. Projects that produce GHG emissions bring about climate change, thereby creating social costs, but they do not face directly, neither via markets nor in other ways, the full consequences of the costs of their actions. The full costs of GHG emissions, in terms of climate change, are not immediately and hardly ever directly borne by the emitter, so they face little or no economic incentive to reduce emissions (Stern, 2007).

All urban infrastructures (buildings, energy, waste, transport) are directly or indirectly (transport encouraged by the construction of roads, energy efficiency in industry) responsible for over 50% of greenhouse gas greenhouse emissions worldwide (IPCC, 2007). Figure 3 shows the emissions per sector.

Figure 3: Global GHG emissions in 2004 per sector



Source: Technical report of Contribution of Working Group III to the Fourth Assessment Report of the IPCC, 2007, World Bank.

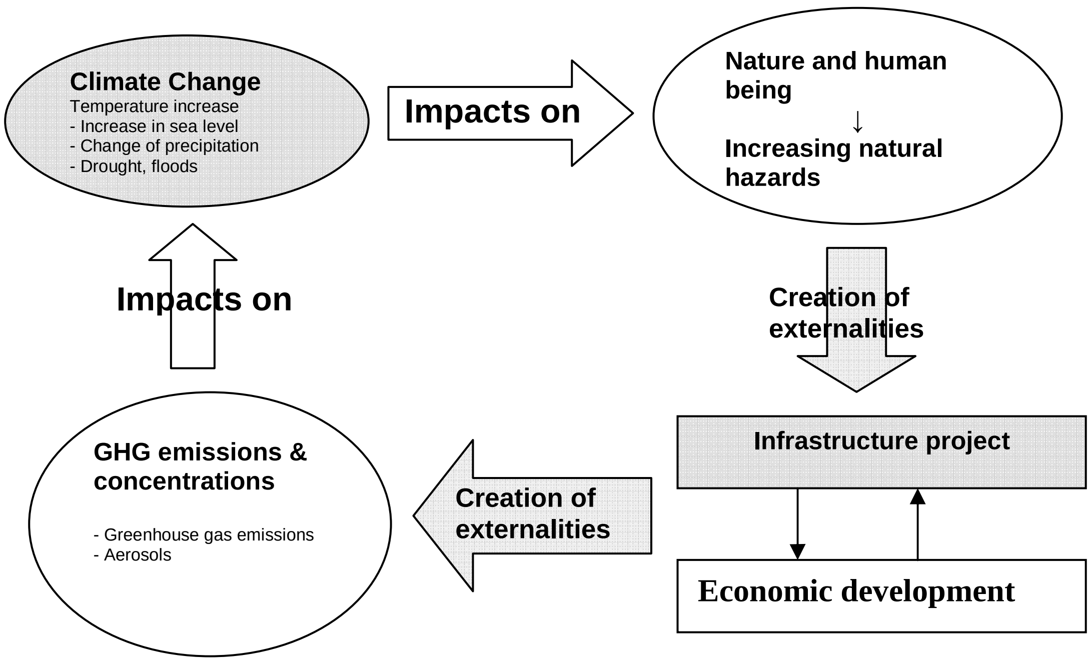
To name some examples how infrastructure can contribute to CO2 emission reduction, the IPCC (IPCC, 2007) can be quoted that estimates that 2.4 to 4.7 Gt CO2eq/year (of which between 1.3 and 2.7 in developing countries) can be reduced in the energy sector by using energy efficiency, renewable energies, nuclear energy and carbon storage and capture technologies. In the waste sector the reduction potential is estimated to amount to 0.4 to 1 Gt CO2eq/year (of which between 0.2 and 0.7 Gt CO2eq/year) by CH4 capture.

On the macro-economic level, there is a need to internalise these externalities as the aggregated emissions of all GHG producers will impact the climate, and climate change is expected to confront infrastructure with great challenges. Higher evaporation rates, rising sea levels, floods and droughts are some of the phenomena that will have an impact on infrastructure assets. Assets of long-term investors are at risk, which increases the vulnerability of economies to climate change.

In fact, climate change increases the frequency and intensity of extreme events, which result in increased economic and human losses. There is statistical evidence that since the late 1980s damage caused by major weather disasters have increased (IPCC, 2007). According to the fourth IPCC report (2007), developing countries will feel most of these negative impacts of climate change, at least initially. 95% of the people affected by extreme events live in developing countries.

Figure 4 pictures the project externalities related to climate change.

Figure 4: Infrastructure and climate change externalities



Source: Based on IPCC Climate Change 2001: Synthesis Report – Summary for Policymakers, modified by the author

2.3 Financial partners in view of economic and climate change externalities

Financial actors involved in the financing of infrastructure investment are diverse.

Due to the fact that infrastructure is either a public good (as it is the case for some social infrastructure) or creates at least significant economic and environmental externalities as described above, the public sector usually plays a pivotal role in infrastructure financing. It can do so either directly through subsidies or by channelling loans through public development banks. In development countries were governments sometimes lack capacity and are short of resources, international bi- or multilateral development banks play an important role in financing and/or subsidising (according to their mandate) infrastructure projects.

Recently an increase in private finance for the realization, maintenance, and operation of public infrastructures has been observed. For the last 20 years there have been significant new developments in private financing of infrastructure due to the lack of public funds and the inefficiencies of public service provision have given rise to initiatives to stimulate private parties to invest their resources in urban infrastructures (Estache, 2006). The private sector comes in as private investors, banks and infrastructure investment funds as well as, more recently, institutional investors (such as pension funds) that look for a stable return in the long run (Holm, 2010).

While public infrastructure investment is carried out to achieve the direct and indirect benefits discussed above (with the requirement that the project is financially sound), private investment decisions are primarily based on financial cost-benefit analysis. Private firms do not consider an environmental externalities in their investment decisions, or when the benefits are very long- term (as with climate change mitigation) and outside the planning horizons of private investments (Stern, 2007). As infrastructure investment are long- term investments, it makes sense for the present analysis to differentiate also between long-term and short-term investors, as long-term investors will take into account to a larger extent the externalities of the projects they finance, whereas short-term investors usually try to materialise their financial profits before long- term external effects materialise.

Long- term external effects created by the project need to be measured and captured in order to remunerate the investor for the benefits he creates. One way to do so is the creation of financial mechanisms. It will be shown in the following chapters how this can be done for the concrete case of long- term externalities related to climate change.

3 Climate change mitigation policy and infrastructure finance

3.1 The economic principles of mitigation policy and implications for infrastructure finance

The aim of climate change mitigation policy in this context is to make project promoters and investors internalise external effects related to climate change in their investment decision. Mitigation policy is based on the economic theory of internalisation of externalities and aims at defining regulatory or economic instruments in order to make promoters use low-emitting technologies.

In the economic literature a variety of instruments has been developed to avoid the tragedy of public goods (tragedy of the commons) and to internalize externalities. Economic instruments are based on the theory of Pigou (1932) that proposes to tax agents who do not adhere to the government's environmental objective. Because of the taxation economic agents will therefore have an incentive to reduce production externalities under the threat of monetary penalties.

The essential element of climate change policy is carbon pricing. As we have seen greenhouse gases are, in economic terms, an externality, which means that the producers of greenhouse gases would not bear the full costs of their actions themselves without government intervention. Putting an appropriate price on carbon, through taxes, trading or regulation, means that those generating GHGs face a marginal cost of emissions that reflects the damage they cause. This encourages emitters to invest in alternative, low-carbon technologies, and consumers of GHG-intensive goods and services to change their spending patterns in response to the increase in relative prices (Stern, 2007).

The implementation of a carbon price results in the creation of a carbon rent. For example, in a cap-and-trade system CO2 emissions are capped by the regulator, which means that emission allowances become rare and a new economic value is created. This economic value is a rent that adds to the costs of the CO2 producers and incentivises them to educe emissions (De Perthuis, 2009a,b).

This carbon rent that is created by any emission trading scheme (such as the Kyoto Protocol) can be captured for project financing by financial mechanisms such as the Clean Development Mechanism.

3.2 The Clean Development Mechanism- mechanisms to monetize the carbon rent

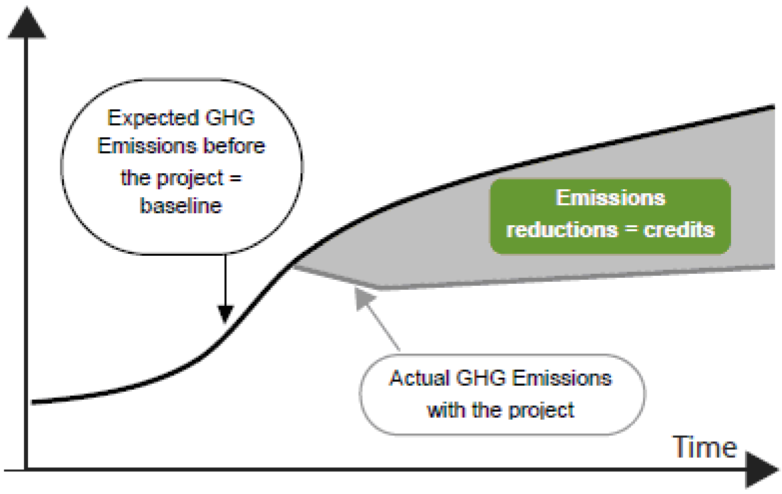
The clean development mechanism (CDM) is a mechanism to monetize environmental value of CO2 emission reduction within projects. It is defined in the Kyoto protocol that was adopted at the Conference of the Parties (COP3) to the United Nations Framework Convention on Climate Change (UNFCCC) held in Kyoto, Japan, in December 1997.

CDM projects take place in a non-Annex I country. The environmental value of CO2 emission (the carbon rent) is captured through generated Certified Emission Reductions (CER), measured in metric tons of carbon dioxide equivalent, that correspond to the reduced emissions compared to a baseline scenario3 (see figure 5).

CERs can be an additional revenue stream (for example, after electricity sales) obtained by a CDM project. Additionality is an important criterion in this context. Only emission reductions that are additional to emission reductions that would have occurred without CDM are eligible. The emission reductions and the sale of CERs must, hence, be a deciding factor in the decision to go ahead with the project or not (Nucifora, 2007).

[3] The precise amount of which is certified by an independent verifier.

Figure 5: CDM mechanisms: the baseline- and- credit principle



Source: Delbosc/De Perthuis (2009)

The theoretical concept of the differential rent that we have already quoted in the previous chapter is the key to understand the role of the carbon rent for the financial engineering of CDM projects. By implementing the CDM mechanisms the Kyoto protocol allows Annex I countries and respective CO2 emitting companies to meet part of their reduction commitments by financing GHG reductions abroad. Since abatement costs differ significantly across countries, sectors, firms and sources, CO2 emitters can benefit from the differential rent described above and arrive at significant cost savings at the firm level, which will lead also to welfare gains at the aggregate national and international level (Janssen, 2000).

However, as generally acknowledged (Stern, 2007; WDR 2010) the presence of a range of other market failures and barriers on both sides of the market as well as for the financial markets mean that the provision of additional carbon revenues to the project is not sufficient to attract equity investment by the project promoter and long- term financiers by banks. In the following chapter it will be shown that the carbon rent has to be efficiently shared between the different project partners in order to remove institutional barriers.

3.3 How to share the carbon rent to attract long-term finance?

3.3.1 The different components of the carbon rent

In the following it will be analysed how the efficient sharing of the carbon rent can attract long-term financing and equity investment.

De Gouvello et al. (2002) state that the carbon rent is made up of the environmental rent, the commercial rent and the social rent, and argue that the collective decision to implement a CDM project will arise from the combination of those three components of the carbon rent and not only from the

environmental rent. The relative proportions of the different components of the carbon rent are negotiated for each project between the various project partners and hence differ between projects.
The *"environmental rent" is* derived from the volume of emission reduction certificates from which specific transaction costs associated with the CDM procedures must be deducted.
The "*commercial rent"* is the value of emission reduction certificates, which is added to the conventional commercial income resulting from the sale of products and services resulting from the main production activity. This commercial rent can make the difference when comparing the business plan for the "clean" project and that for the "dirty" project taken as a reference project.
The "*social or development rent*" is the increase in the supply of products and services necessary for the economic and social development of the country, or the production of positive externalities- versus reduction of negative externalities for the host country.
The three components of the carbon rent will have to be shared between the different project partners, notably the costumers (demand side), the project promoter (supply side) and most importantly the financial markets in order to overcome institutional barriers and market failures that can prevent these partners from paying for or investing in the provision of infrastructure services produced by using low-emitting technology.

3.3.2 The sharing of the carbon rent and long term investors

Long- term investors will be attracted if the profitability (usually measured by the financial internal rate of return) corrected for market and financial risks is competitive compared to other risk-adjusted returns to be earned elsewhere. In the following it is analysed how the sharing of the carbon rent can create incentives for the demand of the infrastructure services as well as investment incentives on the supply side. Consequently, market risks can be reduced for the financier. Subsequently, it is shown how the carbon rent can have an impact on the financial rate of return of a project. These issues are pictured in figure 6 on page 14.

On the **demand side**, customers are reluctant to pay for the surcharge of infrastructure services that use more expensive low-emitting technology. In the developing country, an important issue is the lacking willingness-to-pay for an improved environment given that economic problems seem more pressing. Especially in the case of climate change, the positive effects of CO2 emission reductions are not felt in the short run (WDR, 2010).
The carbon rent can be used to maintain or lower the tariff levels for costumers with ability and willingness-to-pay constraints. Furthermore, parts of the carbon rent can finance further positive externalities for the project beneficiaries[4]. It is the development or social rent that makes the consumers benefit.

[4] The World Bank Carbon Finance Unit's Community Development Fund for example finances social programmes by using a share of the carbon rent.

On the **supply side**, the barriers that prevent certain efficient technologies from spreading spontaneously have their origin in the social and economic environment of the technology. Technological alternatives must compete not only with components of an existing technology, but with the overall system in which it is embedded as the complex scientific knowledge, engineering practises, process technologies, skills and procedures are exceptionally difficult to change in their entirety. Brown et al. (2008) developed the carbon lock-in triangle to explain these phenomena. According to the authors the most important barriers are linked to high transaction costs, lacking incumbent technology support systems and business risks and innovation.
To sum up, the reason why the private sector is reluctant to invest in low-emitting infrastructure is due to the fact that innovative projects provoke risk-adverse behaviour.
Carbon revenues can provide the promoter with stable revenue and, hence, decrease his commercial risks. At the same time the revenue expected ate higher due to the commercial rent.

As far as the **financial markets** are concerned, institutional barriers have an impact on the risk assessment of the borrower by the lender. Furthermore, there are institutional barriers specific to the financial sector of a country that can create a lack of long-term credit. For providers of funds who are concerned about the return and repayment of the funds, institutional factors are crucial during all phases of a credit relationship. In an uncertain environment (such as uncertainties about the market potential of new technologies) and confronted with information asymmetries (the project promoter knows better the new technology), financiers tend to lend on short-term contracts as these permit loans to be repriced in order to reflect new information and to provide incentives to borrowers to avoid bad outcomes (Caprio & Demirgiiu-Kunt, 1997). It can, hence, be assumed that long-term investment is naturally rare for low-emitting projects due to high risk perception.
Similar to the project promoter the risks for the financiers can also be lowered by the simple fact that the commercial rent increases the financial internal rate of return of the project. According to Nucifora (2007), the increases in projects' rates of return as a result of additional revenues from sales of emission reductions at 4$/tCO2e are presented in the following table (figure 7, p. 15).

It has been shown that the efficient sharing of the carbon rent between the different project partners can decrease market risk for the investor/financier and increase its financial rate of return. However, financial risks may still persist and can prevent the provision of capital for CDM projects. Measures developed by the World Bank to tackle these problems are presented in the next chapter.

Figure 6: Sharing of the carbon rent between the different project partners

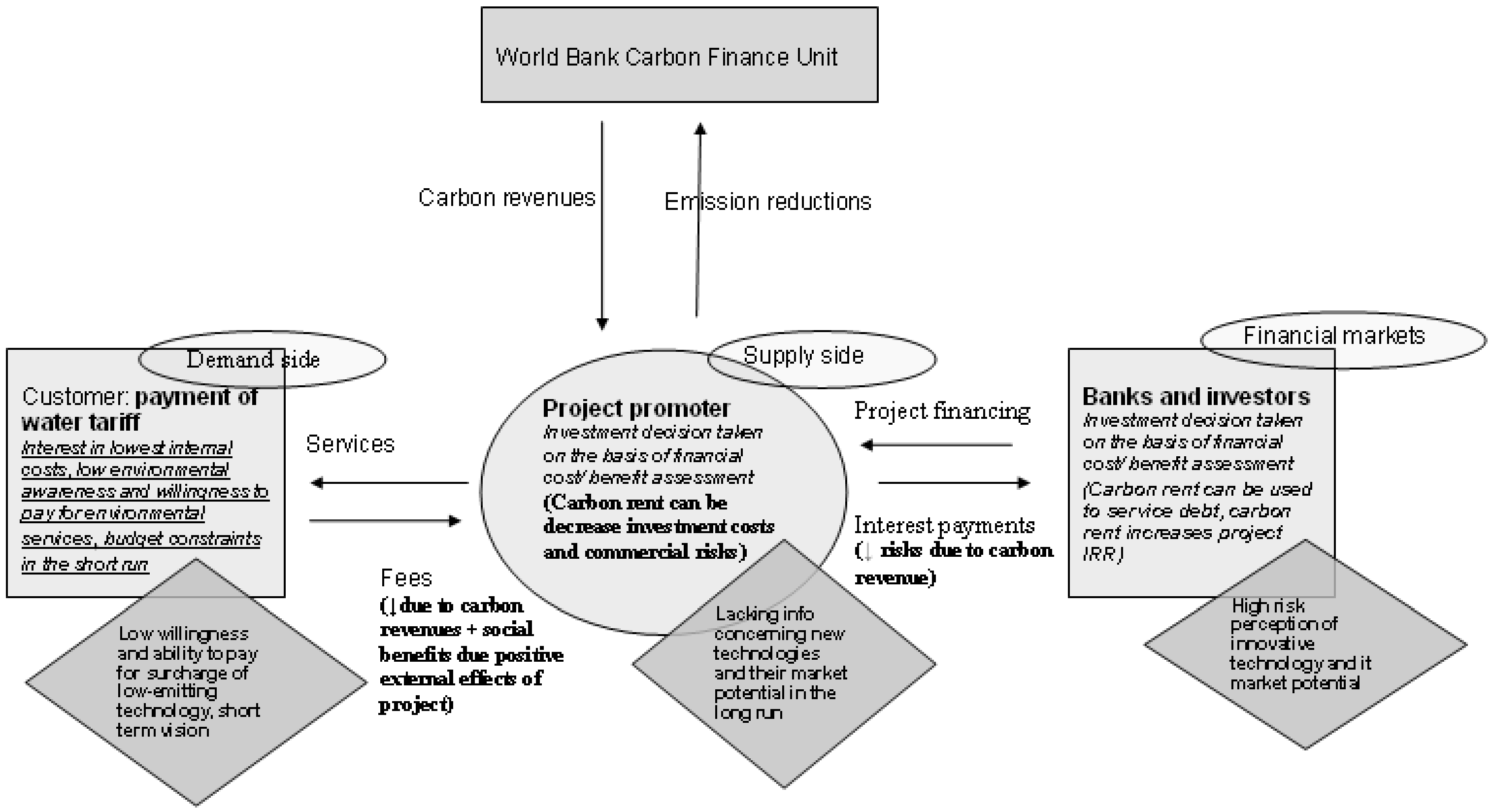


Figure 7: Increase in financial rate of return due to carbon finance

Technology	Increase in financial rate of return (IRR)
Hydro, Wind, Geothermal	0.5 – 3.5 %
Crop/Forest residues	3 - 7%
Municipal solid waste	5-15%

4 The World Bank on the CDM market: quest for additional capital

The efficient sharing of the carbon rent as part of the financial and contractual design of the emission reduction purchase agreement is in many cases not enough to leverage additional finance as financial risks and uncertainties related to the innovative character of CDM projects as well as financial risks related to the host country and financial market institutions persist (among others Huhtala/Ambrosi, 2009). The role of the World Bank on the CDM market has therefore been two-fold. It has not only helped to prepare the market for investment in emission reduction credits of CDM projects (chapter 4.2), but has also tried to attract different long-term financiers by different measures of financial engineering and by proposing adequate risk-sharing measures that will be explained in chapter 4.3. In chapter 4.4 a case study of a carbon offset project is presented in order to show for a concrete example how the sharing of the carbon rent and financial risk allocation can work in practice. The chapter begins with a presentation of the different capital providers- those active on the primary market for Certified Emission Reductions and those involved in the financing of the project itself.

4.1 The World Bank and other financial actors on the CDM market

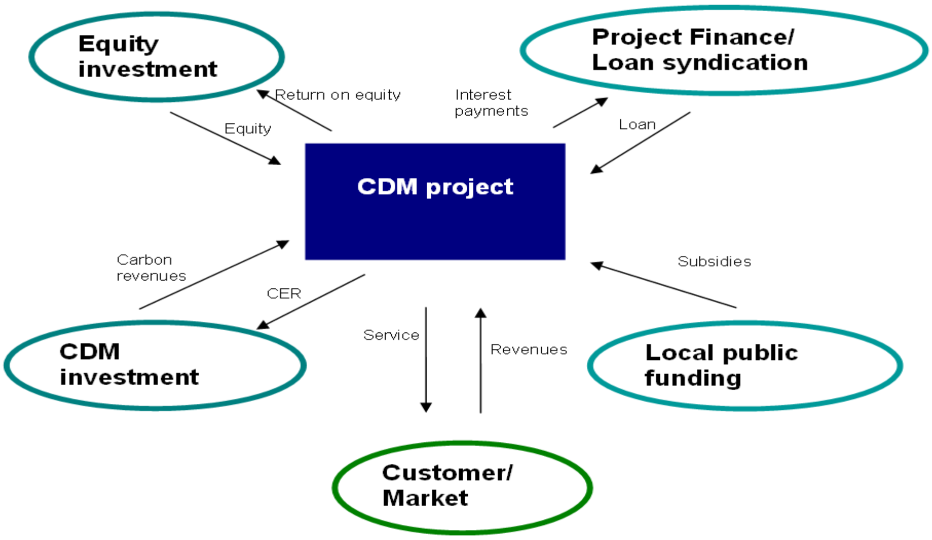
Capital providers on the CDM market have become diverse. Firstly, there are those active on the market for primary Certified Emission Reductions (CER)[5], so-called carbon credits. Carbon credits can, in fact, be acquired by different actors at different stages in the primary market. Stephan & Alberola (2010) group buyers of carbon credits on the primary market in distinguishing between companies engaged in trading schemes for emission allowances, financial investors covering carbon funds, banks and financial intermediaries, and finally the professional developers of CDM projects.

As regards the project financing of the CDM projects, important actors are the project promoters providing equity investment, private, bilateral and multilateral banks providing loans either alone, in a bank consortium or through project financing. Other important partners are local governments and agencies (such as energy agencies) which provide either subsidies or loans to the project.

[5] The market for secondary CERs is neglected as an investment in secondary CERs does not lead to an investment in a CDM project.

Figure 8 pictures the different financial partners of CDM projects.

Figure 8: Financial structure of CDM projects



Despite its role in attracting private and public investment in carbon assets through carbon funds, the World Bank has played a role in the financial engineering of the projects that signed emission purchase reduction agreements with the Carbon Finance Unit. It has been part of the strategy of the World Bank to not only attract financing on the primary CER market, but also additional project financing for CDM projects. This hypothesis is derived from the fact that only roughly 20% of projects that sold emission reductions to World Bank Carbon Funds benefited from financing or grant funding from the World Bank Group (World Bank, IFC or IDA)[6].

4.2 The World Bank's role on the primary market for carbon credits

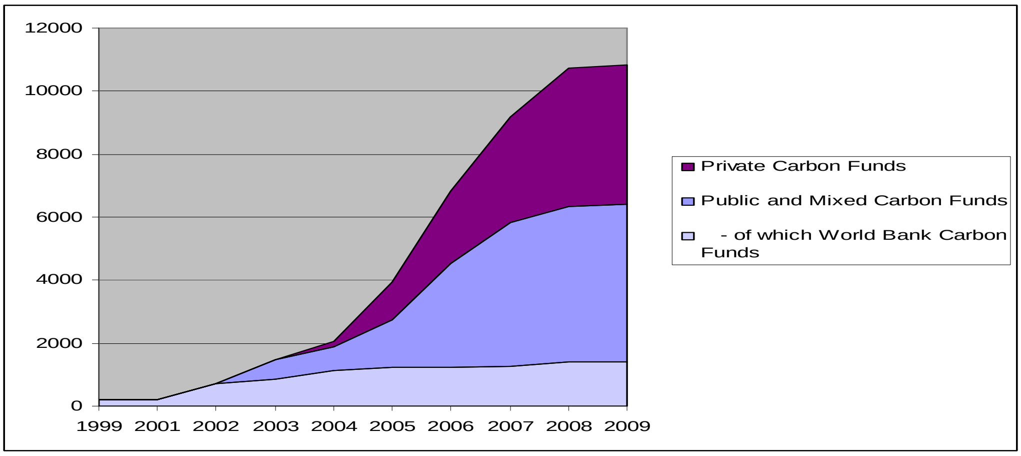
As the World Bank has been active on the primary CER market through its carbon funds, we focus here mainly on carbon funds as far primary market for carbon credits is concerned.

Carbon funds are investment vehicles which raise public and/or private capital to purchase carbon credits on the primary market.
The first fund, the Prototype Carbon Fund, was launched by the World Bank in 1999, which was even before the official implementation of the CDM mechanism with the ratification of the Kyoto Protocol. The development of carbon funds has accelerated since 2005. In late 2009, the fund industry accounts

[6] These estimates are based on the 51 projects analysed in the database used for chapter 5 of this article.

for 96 carbon funds for investment in emission reduction projects against 66 funds in 2007. These 96 carbon funds announced a total capitalization of 10.8 billion euros in 2009, an increase of capital by 54% since 2007 (Stephan/Alberola, 2010).
The following chart (figure 9) pictures the evolution of public, private and mixed carbon funds.

Figure 9: Evolution of the secured capital by investor type (in Million Euro)



Source: CDC Climat Recherche based on Environmental Finance 2010 data, Point Carbon and websites of the funds.

The World Bank Carbon Funds have played the role of trendsetters. They attracted public and private investors in their carbon funds before 2005, when the Kyoto protocol had not entered into force to develop expertise with private and public financial actors. From 2005 onwards, private carbon funds and public and mixed funds have grown rapidly, while the secured capital by World Bank Carbon funds remained stable. Today, the World Bank Carbon Finance Unit manages around US$2.5 billion across its carbon funds and facilities according to the website of the CFU.
Some of the main funds and facilities managed by the World Bank Carbon Finance Unit are presented in figure 10.

The public and private carbon funds that have emerged in recent years vary from structures which invest directly in projects to reduce greenhouse gas emissions to financial players buying credits on secondary markets. These investors have a wide range of different motives and strategies. 52% of the funds purchase directly carbon credits, while 23% funds invested in CDM projects (Stephan & Alberola, 2010).
Funds that invested in CDM projects, beyond the investment in the carbon credits, may provide additional capital or/and bear project risks. This can be done in the following ways. The investor can offer equity investment in the CDM project. In return for equity in the project it receives a share of the CERs arising from the project. Alternatively, the fund may take equity in the form of shares in the company or the investor can be involved as financier to the underlying project. He provides a portion

of project finance in the form of a loan and receives CERs as a part payment of a fixed proportion of the interest for that loan (UNEP RISOE, 2005).

Figure 10: World Bank Carbon funds

Vehicule name	Eligible investors	Vehicule classification	Secured capital (million)	Invested capital (million EUR)	Launched	Final closing	Date to be fully invested
Community Development Carbon Fund (CDCF)	Public and Private	Credit Fund	128,6	67,97	2002	2005	2017
Danish Carbon Fund (DCF)	Public and Private	Credit Fund	90		2005	NA	2009
Italian Carbon Fund (ICF)	Italian government and italian companies	Credit Fund	155,6		2003	2006	2014-2016
Netherlands Clean Development Mechanism Facility (NCDMF)	The Government of the Netherlands	Project Fund	228		2002	NA	NA
Netherlands European Carbon Facility (NECF)	The Government of the Netherlands	Credit Fund			2004		2008
Prototype Carbon Fund (PCF)	All World Bank member countries and public and private entities based in these countries	Credit Fund	220	220	1999	2000	2014
Spanish Carbon Fund (SCF)	Public and Private spanish entities	Credit Fund	280	220	2004	2008	2017
IFC-Netherlands Carbon Facility (INCaF)	The Government of the Netherlands	Project Fund	100	65	2002	ND	2008

Source: Environmental Finance

It has been shown that a great variety of financial products has developed that capture the carbon rent for financial investors. Consequently, investors can chose to invest in CER, in the CDM project itself or go for a mixed strategy. In practice, several of these different types of actors will be involved in the project financing at the same time. The contractual arrangements for the individual project will settle the sharing of the carbon rent as well as the risk sharing. In the next chapter the principles of this risk sharing will be analysed.

4.3 Financial and contractual design of World Bank Carbon Offset projects

As observed in the previous chapter the carbon market has grown quickly over the past few years, but challenges and barriers remain that considerably reduce the transformational impact of carbon finance (Huhtala & Ambrosi, 2009). CDM projects face a number of structural challenges in obtaining any form of financing, and particularly bank debt (CD4CDM, 2007). In order to make projects financially attractive for private, multilateral and bilateral banks and investors and to mobilise hence long- term financing for new technologies, notably country risks, project risks and CDM specific risks have to be mitigated (UNEP RISOE, 2005; UNEP and Partners, 2009).

Country risks are macroeconomic risks (currency risk, risk of economic crises, etc.) and political risks (risk of expropriation, etc.) that make lenders to developing country projects often require higher interest rates or repayment over shorter loan terms than the project's revenues can support.

Project risks are related to the fact that projects are typically relatively small and that climate-friendly technologies such as renewables are usually more capital intensive than fossil fuel alternatives. Other project risks are, among others, the demand risk, the borrower default risk and environmental risks.

CDM specific risks are related to uncertain revenues associated with CER. For example, the baseline may need to be adjusted during the crediting period due to technological changes or changes in the demand and the activity level. There are also uncertainties about costs, such as transaction costs and project cycle costs and uncertainties about the renewal of the crediting period (Janssen, 2000). Trotignon/ Leguet (2009) find that the risk of delay of validation, registration and verification can be significant as well. Furthermore, there is the risk that all projects at validation will not be registered as well as the risk of under/over performance.

In the first years of the CDM market development the World Bank put in place risk mitigation measures to lower the risks for partner financiers and investors. The most widely discussed measures in World Bank publications include the following.

The carbon purchase agreements can be structured in a way that the most stable and longest revenue stream is provided for by the project. This is meant to render the project financially stable and attract private investors (Bishop, 2004). For example, the carbon delivery and currency risk has been mitigated by the World Bank Prototype Carbon Fund through offering emission reduction purchase agreements for 10 or more years, denominated in US$, with the World Bank as trustee of the PCF.

Another example is the use of an escrow account for CER revenues, which enables the project promoter to borrow against these revenue streams and to use the carbon revenues to service debt. Moreover, placing the escrow account outside the host country mitigates currency convertibility and transfer risk (Bishop, 2004). Furthermore, this can overcome barriers due to information asymmetries between bank and sponsor as the carbon revenues are paid directly to the bank. The default risk is, hence, minimised for the borrowing bank. This method was used for the Brazil Plantar project that sold its carbon credits to the Prototype Carbon Fund and received private financing from Rabobank (Bishop, 2004 and CD4CDM, 2007).

More traditional risk mitigation instruments, such as guarantees to mitigate performance and repayment risk, linked for instance to currency, interest- rate or commodity- price risk, technology risk or non-commercial risk can also be used as laid out by Huhtala & Ambrosi (2009).

4.4 A case study: The Rio Frio Wastewater Treatment Project

It has been shown that financial contracting for CDM projects should aim at efficient sharing of the carbon rent between the project partners and at allocating financial risks between the financial partners. The following case study shows how this can look like in practice.

The project

The development objective of Rio Frio wastewater treatment project[7] is to reduce greenhouse gas emissions from the wastewater treatment sector in the metropolitan area of Bucaramanga, Colombia through modernization. The project will be developed, managed and operated by Corporacion Autonoma Regional para la Defensa de la Meseta de Bucaramanga (CDMB), which is a regional public sector entity. This modernization of the waste water treatment will result in abatements of methane (CH_4) and nitrous oxide (N_2O) emissions of about 39 kilo tons of carbon dioxide equivalents per year (ktonCO2eq/year) and in an improved effluent quality from the plant.

Carbon credits and risk mitigation measures

The certified emissions reductions are estimated to amount to US$ 2.6 million up to 2020; and to US$1.6 million up to 2016 by using a carbon price of US$ 4.75 per ton of CO2e. The emission reductions are purchased through the World Bank's Carbon Finance Unit's Community Development carbon funds, and within the framework of the Kyoto Protocol's Clean Development Mechanism (CDM). The carbon credits will be bought in advance by the World Bank, which means that the World Bank bears the risks related to the delivery of the carbon credits and that safe revenue will be provided to the project promoter until 2020, which covers basically the whole project period of 14 years.

Carbon rent sharing

It is put forward at several occasions in the appraisal report that the CDM mechanism substantially helped to overcome asymmetries related to the low willingness and ability to pay of the final costumers. In Colombia where the national income is rather low (in 2008 the gross national income/capita stood at 4660 $[8]) and little environmental regulation is in place concerning CO_2 emissions, there is little willingness to pay for the low-emission waste water services.

It is shown in the financial analysis that the user charges that cover investment and operating costs for the expansion and improvements of the wastewater treatment plant, are reduced by 30% thanks to the income offered by CERs.

[7] The information given here is based solely on the World Bank appraisal report that is available publicly on the World Bank project website. The information is ex-ante. The project has not been implemented under the CDM mechanism yet. For the time being it is not mentioned in the CDM pipeline provided by UNEP RISOE.

[8] World Development Indicators 2008

Furthermore, a social (community benefits) program is supported with 15% of the net revenues from carbon emission reductions. The program addresses domestic violence and unwanted pregnancies and related health conditions (STD and HIV/AIDS).

Financing of the project

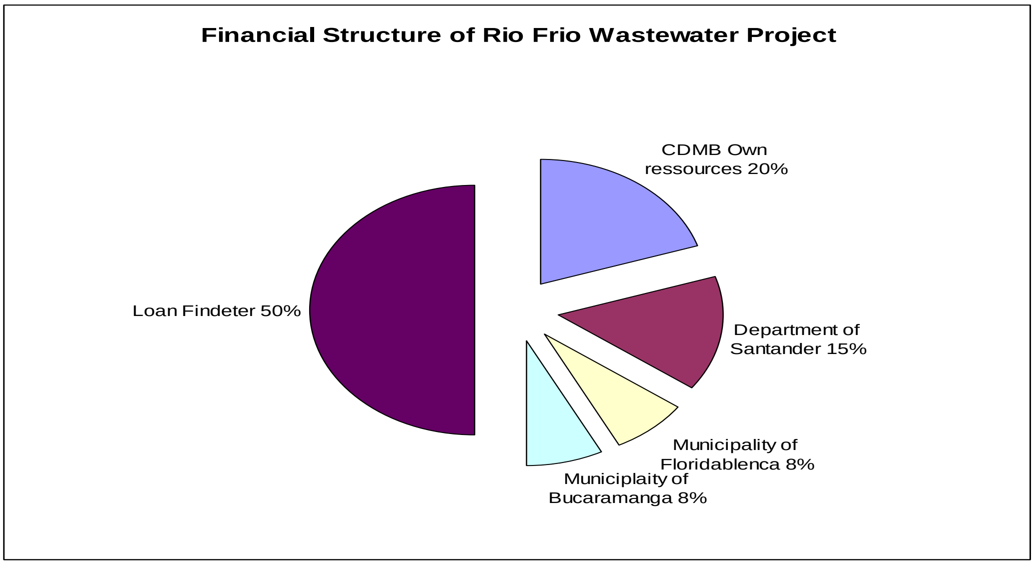
The total project costs amount to US$ 10.7 million in the first stage of the project, excluding the transaction cost associated with the emission reductions as well as the social program. The project will expand its capacity in 2012 implying an additional investment of US$5.3. The carbon revenues represent roughly 10% of total project costs.

The internal rate of return (IRR) and the net present value (NPV) are significantly higher. The IRR rises from 13.61 % to 17.66 %. The NPV was calculated to stand at US$ 1.67 million without carbon revenues and at US$ 2.85 million with carbon revenues. The carbon revenues are thus a key factor for the improvement of the financial viability of the project.

The project is funded by the department of Santander and of the municipalities of Bucaramanga and of Foridablanca, which provide non repayable subsidies. The promoter will contribute 20% of the investment and will cover the interests of the loan during project execution. Process for obtaining the debt capital from Financiera de Desarrollo Territorial (FINDETER) (50% of total) was underway when the appraisal report was published. The project does not involve World Bank lending or any other multilateral or bilateral financing. The FINDETER loan can be regarded as local long- term financing. The loan is regarded as less risky by FINDETER due to carbon credits that represent a reliable revenue stream until 2016. The project benefits from 50% local long- term financing.

The following pie charts pictures the financing structure of the project.

Figure 11: Financial structure of Rio Frio Wastewater project



Source: Rio Frio World Bank Appraisal Report

In the following empirical study we describe the financing structures of a bigger portfolio of projects for which an emission reduction purchase agreement was signed with the World Bank Carbon Finance Unit.

5 Empirical study: financial and contractual structures of World Bank Carbon Offset projects

5.1 Methodology

In this empirical analysis, the financial structures of historic World Bank carbon offset projects are analysed. In the previous analysis of this article it has become apparent that the financing structure of any project will be tailored to take into account the desire for rent and risk sharing between the different project partners. The question therefore arises as to who the partners of the World Bank for the financing of these projects are, and, what factors (country, project type, amount of carbon rent) impact upon their financing decisions.

As far as the project types are concerned, social and economic infrastructure projects are analysed separately and the impact of the carbon revenues on the long- term financiers' behaviour is analysed.

After having described the database that was constructed for this analysis, a descriptive analysis of the different partners involved in the financing of the projects that signed an emission reduction agreement with the World Bank Carbon Finance Unit is carried out.

Subsequently, it is analysed whether the project partners vary between projects implemented in different countries and whether the national income of a country can explain the amount of long- term financing provided.

The financial structures of social and economic infrastructure are compared in the following chapter, where it is also shown what the influence of the carbon rent on long- term financing is.

A simple statistical approach is used to investigate these issues as not enough data is available to carry out an econometrical analysis.

5.2 Data

For this empirical study a database based on the official project design documents (PDD) and World Bank appraisal documents[9] was constructed. The data has to be treated with caution as it is ex ante data and the WB appraisal reports have often been drafted well in advance of CDM registration. The values of loan and equity amounts are, hence, only indicative[10]. The database provides financial data on projects for which emission reduction purchase agreements were signed with the World Bank Carbon Finance Unit. Reforestation projects were excluded: because of their particular characteristics

9 Available on the World Bank and UNEP RISOE websites.

10 However, values that were labelled indicative in the appraisal reports were excluded from the analysis.

they are not comparable to other projects. For the same reason the BioCarbon fund projects are excluded from the analysis.

51 registered projects were left for the analysis, of which for 32 projects qualitative information on the financing structure is available in the PDD or World Bank appraisal reports. Out of these 32 projects there is quantitative information provided for 16 projects. It is important to note that this could potentially mean that the data is biased. Possibly only for those projects detailed information in the PDD and the World Bank Appraisal Document is provided where no commercial banks are involved, as financial data is often confidential.

All 32 CDM projects in the database were registered by the Executive Board of the CDM between 2005 and 2009.

Of the 16 projects for which numerical data is available, 6 projects were managed by the Community Development Fund, 1 by the Danish Carbon Fund, 1 by the Italian Carbon Fund, 4 by the Netherlands Clean Development Mechanism Facility (NCDMF), 3 by the Prototype Carbon Fund, and by the 1 Spanish Carbon Fund. This means that the proportions in the database do not fully reflect the proportions of projects in the overall project portfolio of the World Bank Carbon Finance Unit. As the amount of projects is already limited this fact was ignored for the following analysis.

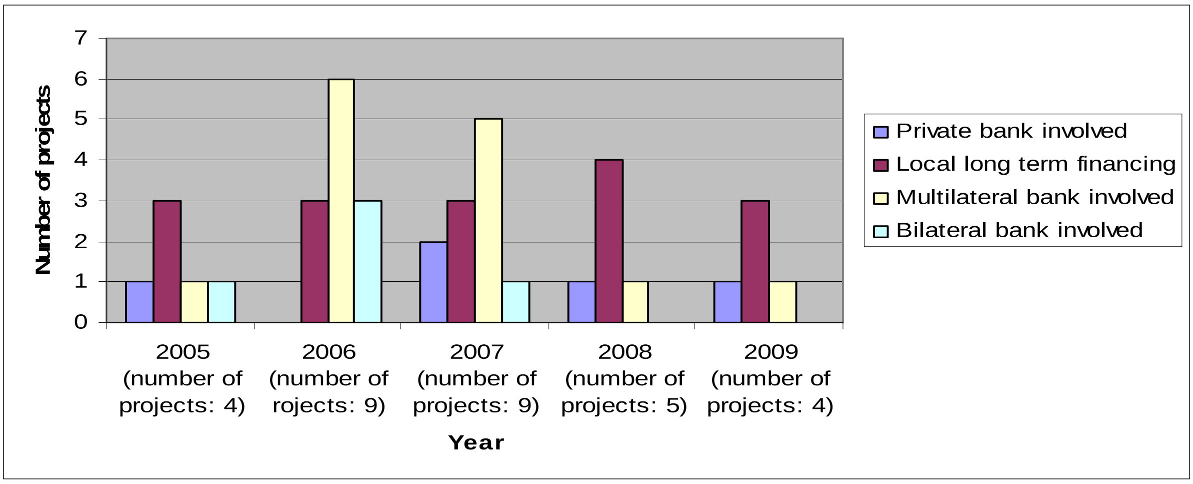
5.3 The financial partners of the World Bank in Carbon Offset Projects

In order to analyse the financial structure of the different projects, the capital providers were grouped into four different groups: private banks, multilateral and bilateral banks and local public financiers. Private banks have a purely commercial objective and do not spontaneously take into account project externalities, whereas multilateral and bilateral banks also have a political mandate, which can consist in financing projects with significant external development benefits[11]. Local public financiers are for example local governments, energy agencies etc. that also consider project externalities in their financing decision.

For the sample of 32 projects for which at least qualitative data is available it is analysed how many projects have received financing from each one of the 4 different groups of financiers distinguished above (figure 12). Projects typically receive financing from several financiers.

[11] Atteridge et. al. (2009) provide a good overview over the different approaches of bilateral, multilateral and private banks in the face of climate change.

Figure 12: Sources of financing of WB Carbon Finance Unit projects in different years

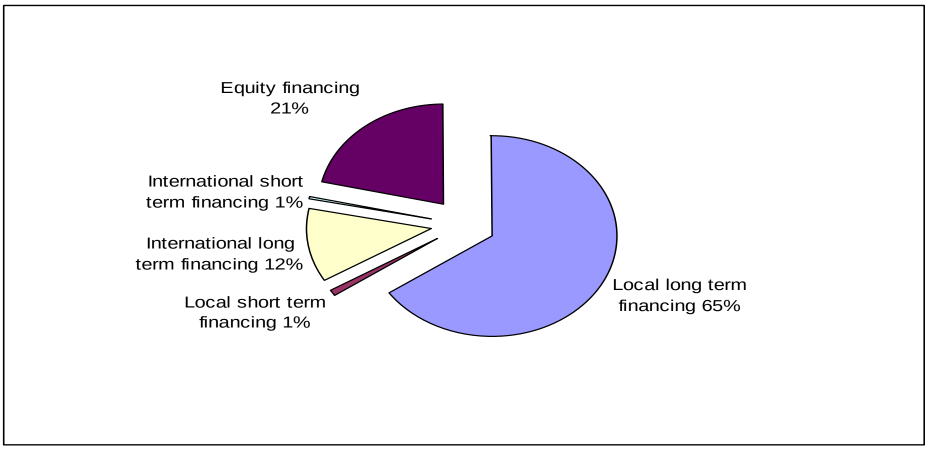


Help for the reader: The chart has to be read as follows. For 2005 information on 4 registered projects is available. 1 project received financing from a private bank. 3 projects were partly financed by local long- term sources. Multilateral development banks where involved in 1 project and so were bilateral development banks.

Local long- term financing (which is mostly public finance) seems to be a stable component of financing. Multilateral financing was especially important in the years 2006 and 2007, when more projects benefited from multilateral financing than from local public financing.

The reduced database which contains detailed numerical data for the financing structure for 16 projects provides more detailed information on the overall financing structure of CDM projects which benefit from emission reduction agreements with the World Bank carbon finance unit. 6 of these projects were financed entirely out of the promoter's equity. The following pie chart represents the financing structure of those 10 projects with a mixed financing structure. The percentages of local and international long- term financing as well as local and international short term financing of the overall investment costs of the 10 projects were calculated. The aim is to understand how much capital was provided by the different categories of financiers to finance the overall investments undertaken.

Figure 13: Overall financial structure of portfolio of World Bank Carbon Finance Unit projects



"Local long- term financing" refers to either local governmental programs (such as the Mexican concept of Financed Public Project or "Obra Publica Financiada" ("OPF") or national energy agencies) or local development banks (such as Brazilian Development Bank (BNDES). Commercial bank financing was only added in this category when it was explicitly mentioned in the document that it was long- term financing (like financing from the Industrial and Commercial Bank in China[12]). Otherwise commercial bank financing was assumed to be short term. International multilateral and bilateral financing (such as financing from the World Bank Group, KfW or others) has been regrouped under the name "international long- term financing". Long- term finance provided from foreign private banks would have been added here as well, but there was no case where an international commercial bank provided long- term finance to a project.

Local short term financing refers to loans by local private banks, whereas international short term financing refers to loans from foreign private banks.

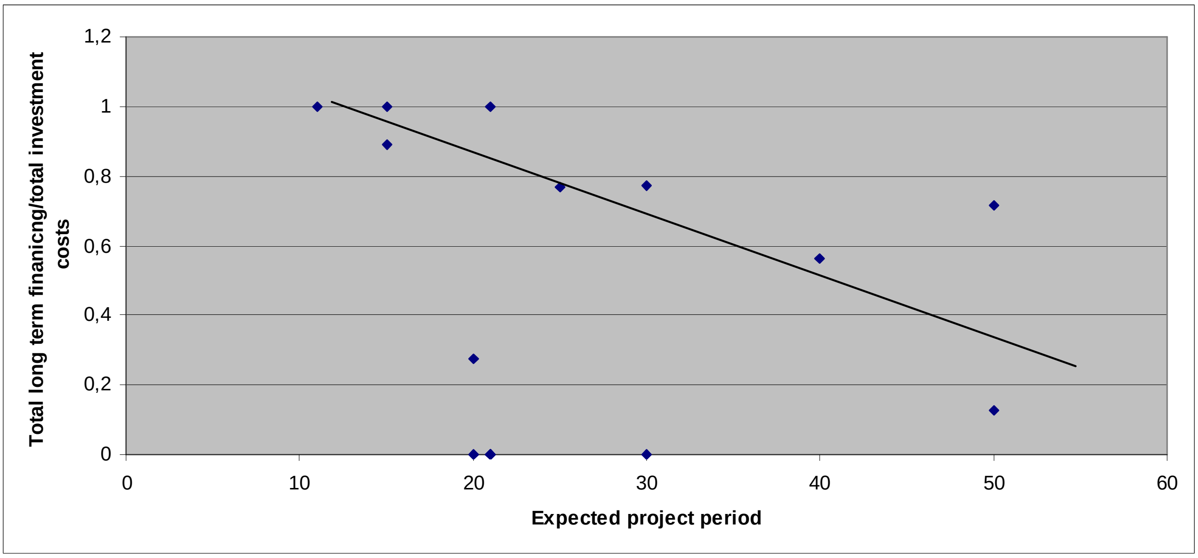
Of the overall investment costs of the 10 projects, 65 percent were financed by long- term local financing, international long- term financing was mobilised for 12% of all infrastructure assets of the 10 projects scrutinised. Short term financing and private banks play a minor role.

In order to understand what the investment horizons of those financiers are that were classified as long- term investors, the relationship between the "total long- term financing over the total investment costs" and the **project period**, which is the expected project period as indicated in the PDD, is analysed. The overall investment costs of the projects represented here are mostly financed only by long- term investors and equity (as can be seen in figure 13). Keeping this in mind, this chart could be interpreted as follows. For longer project periods more equity is provided as long- term financing is less available than for shorter project periods. When analysing separately local long- term financing

[12] In China it is difficult to distinguish between commercial and development banks. Financing from banks like the Industrial and Commercial Bank in China are added in this category even though when it is not explicitly marked as long term.

and international long- term financing, the trend can be confirmed for total international long- term financing, but much less so for local long- term financing.

Figure 14: Relationship between long- term financing/total investment costs and expected project period[13].

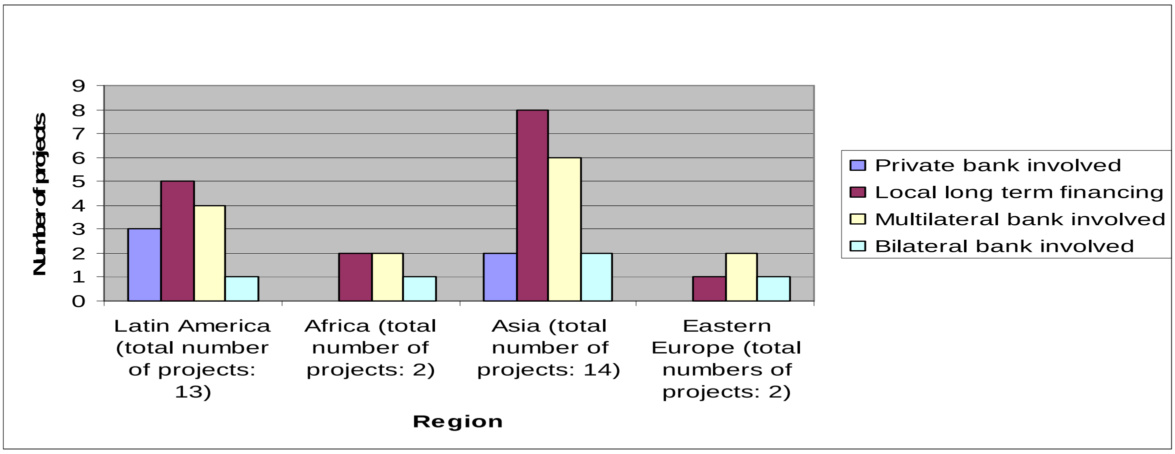


5.4 Financial structures in different regions and countries

Another interesting exercise is to analyse whether strategies of long- term investors vary between the different countries. In a first step it was analysed how many projects received financing from private, bilateral and multilateral bans as well as local public sources[14].

[13] On the x-axis three projects are represented that have a project period of 20 years and two projects that have a project period of 21 years.
[14] The distinctions made are the same as in chapter 5.3.

Figure 15: Sources of financing of WB Carbon Finance Unit projects in different regions



In Latin America and Asia, the two regions that are represented by the highest number of projects, local public long- term financing is more important than multilateral bank financing. Private banks (that assumably provide short term financing) are also only present in these two regions – however with minor importance.

It is investigated whether the variable "total long- term financing/total investment costs" can be explained by the gross national income (GNI) of the host country.

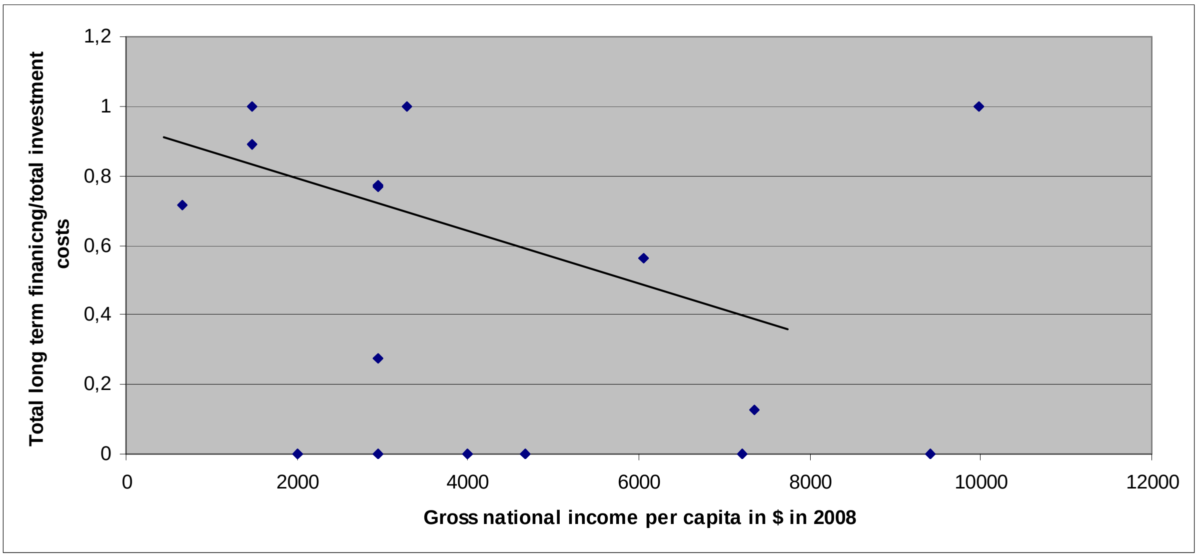
There seems to be a trend that the poorer a country is the more long- term financing is used compared to equity financing (it can be assumed that total investment costs are either financed by long- term financing or out of the promoters' equity as the database contains only two projects with commercial short term financing and those projects should not have an impact here). The trends are the same for local and international long- term financing that have been analysed separately.

From the economic theory described in chapter 3 of this article we would have expected that long-term financing is more abundant the more developed a country is and the more developed and transparent its financial markets are as informational asymmetries between lender and borrower are much lower in this case.

A possible interpretation for this inversed trend that is observed here could be that in the poor countries public financing is easier to mobilise than private financing. It can be assumed that the projects are not only chosen for their financial attractiveness but also because they generate positive development externalities. Especially the Community Development Carbon Fund (CDCF), which is overrepresented in our database with 6 projects, has the clearly defined mandate to provide carbon finance to projects in the poorer areas of the developing world. The CDCF uses systematically a share of the carbon rent to finance social development projects in the project region.

Another explanations for the trend observed in figure 16 is that long- term financing as defined for this analysis (detailed in chapter 5.4) turn out to be mostly public financing in the projects analysed. The institutions providing this capital are capable of assuming a higher degree of risks than commercial banks can.

Figure 16: Relationship between total long- term financing and national income[15]



5.5 Different financial structures of economic and social infrastructure and carbon revenues

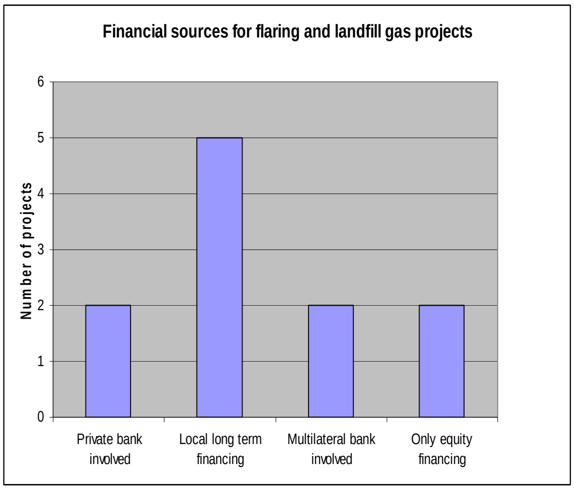
As far as the different project types[16] and their financing structure are concerned, it is especially interesting to look at flaring and landfill gas projects as well as hydraulic projects. Landfill gas projects are regarded as social infrastructure whereas hydraulic projects are regarded as economic infrastructure. As detailed in chapter 2 of this article the difference between these two types of infrastructure is that no revenues are generated by social infrastructure as this type of infrastructure usually provides public goods, whereas economic infrastructure investment is remunerated by revenues paid by costumers for the provision of a private good (like electricity).

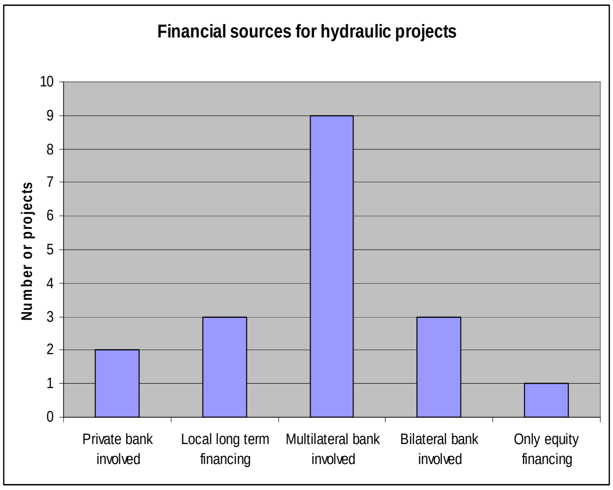
Information is available for 8 out of 14 for flaring and landfill gas projects and for 10 out of 15 hydraulic projects. The number of projects where on particular category of financiers (as in figure 12 and 15) are involved are presented in figure 17.

[15] The linear slope has been manually added to indicate the general tendency of the point presented. No regression analysis has been carried out. The same is true for the following charts.

[16] One project in the hydraulic sector in Latin America was financed by a credit from the promoter's holding company. Due to the particularity of this financial arrangement compared to the other projects this project was not included in the following analysis.

Figure 17: Sources of financing for flaring and landfill gas recovery and hydraulic projects





For flaring and landfill gas projects local long- term financing is especially important. 5 out of 8 projects received financing from this source. Multilateral banks are involved in 2 projects. However, multilateral banks were involved in 9 out of 10 hydraulic projects. As expected from the theoretical analysis, financial structures seem to be different between social and economic infrastructure.

As far as emission reductions generated by the different types of projects are concerned, flaring and landfill gas projects generate the highest emission reductions.
The same is true for the total amount of carbon finance that the project benefits from during the first crediting period expressed as a percentage of the overall investment costs.
For hydropower projects the ratio "total amount of carbon finance for initial period/total investment costs" varies between 2% and 25%. For flaring and landfill gas recovery the ratio is between 400% and 740%. The reason why these ratios are so high is also because the investment costs of flaring and landfill gas are significantly lower (between 0.2 and 7 Million US $ for the projects in the database) than for hydropower projects (between 13 and 79 Million US $ for the projects in the database).

As we have seen before (cf. figure 17) the predominant source of financing for flaring and landfill gas projects is local long- term financing, whereas for hydraulic projects multilateral financing is the predominant one.
Interesting questions for further analysis arise. Multilateral banks seem to play a more important role in projects that generated less carbon credits (as a percentage of investment costs) but also other revenues levied through fees. Local long- term financing seems to be more important for projects that generate relatively more carbon revenues (as a percentage of investment costs) but can only levy very low user charges.

Figure 18: CO2 emission reductions in first crediting period for different project types

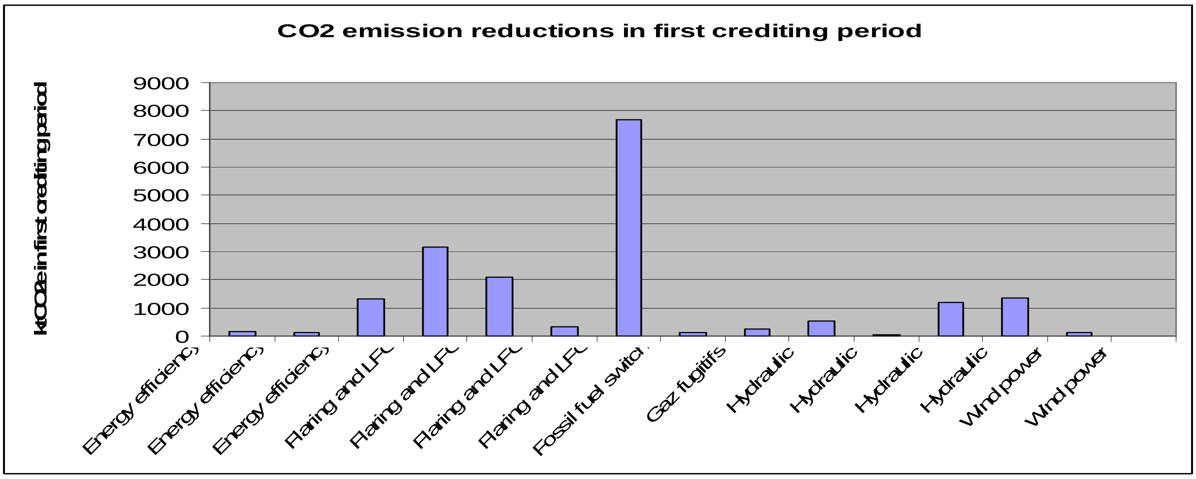
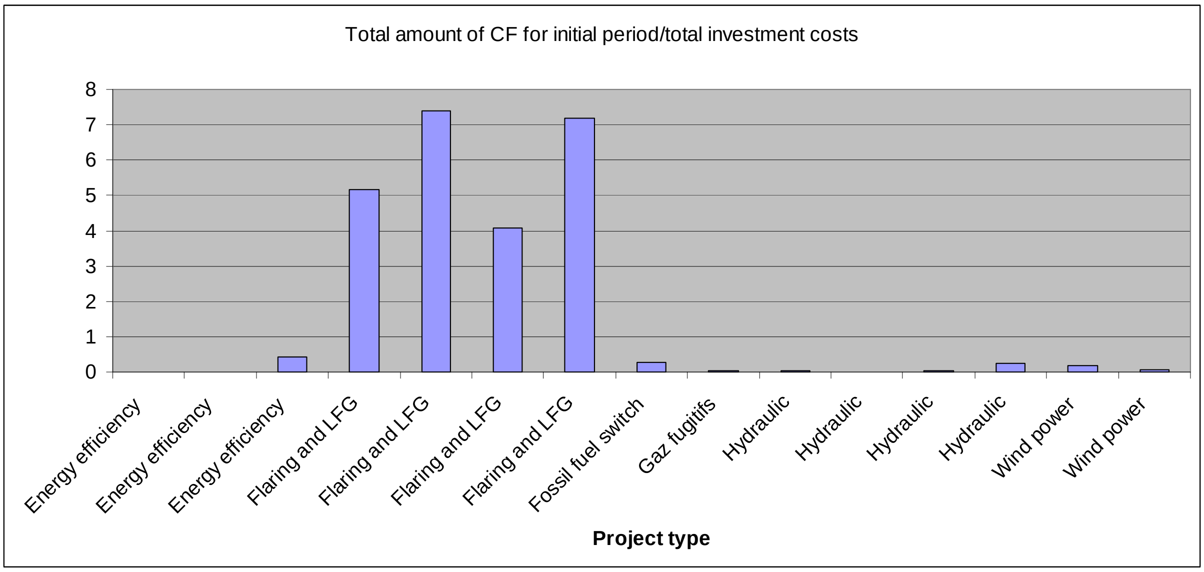


Figure 19: Total amount of carbon finance/total investment costs for different project types



It makes sense to analyse the relationship between the total amount of carbon finance received by the project and the total long- term investment as a percentage of total investment costs separately for social and economic infrastructure. The total amount of carbon finance for the initial CER crediting period was calculated by using the amount of CO_2 emission reduction equivalents for the first crediting period (ktCO2e) multiplied by the number of years of the first crediting period (both as indicated in the UNEP RISOE pipeline) and the yearly weighted average of the price for CERs as indicated in the World Bank's "State of the carbon market report" for the respective year. For the analysis energy and industrial projects are regrouped under the name « economic infrastructure », whereas the term « social infrastructure » describes landfill gas recovery and waste projects.

The relationships between the total amount of carbon finance as a percentage of overall investment costs and long- term financing as a percentage of overall investment costs are presented in chart 20 for economic infrastructure and in chart 21 for social infrastructure.

Figure 20: Relationship between carbon finance and long- term investment in economic infrastructure

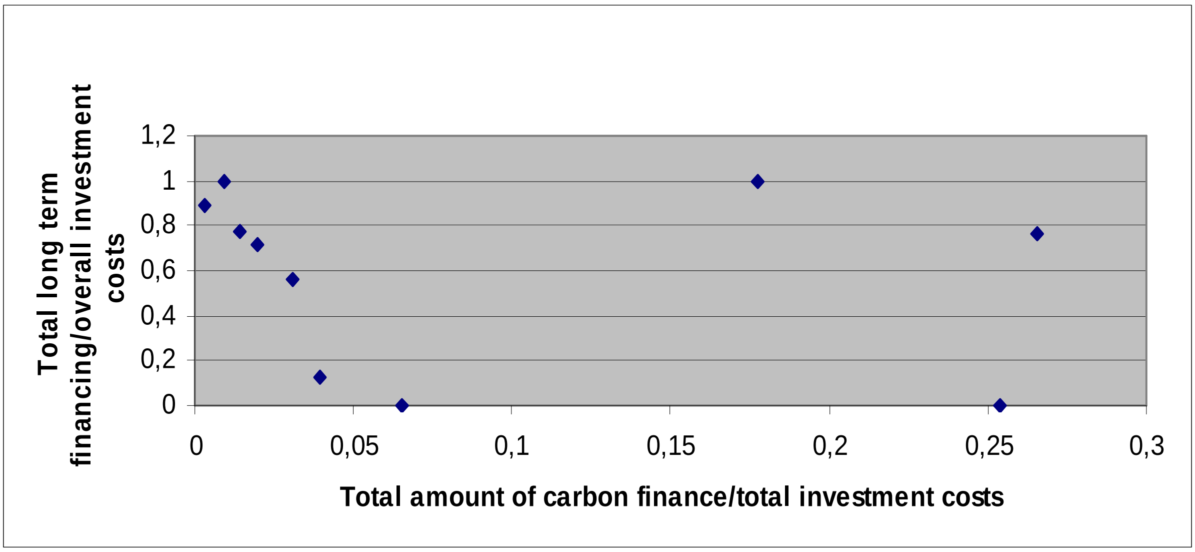
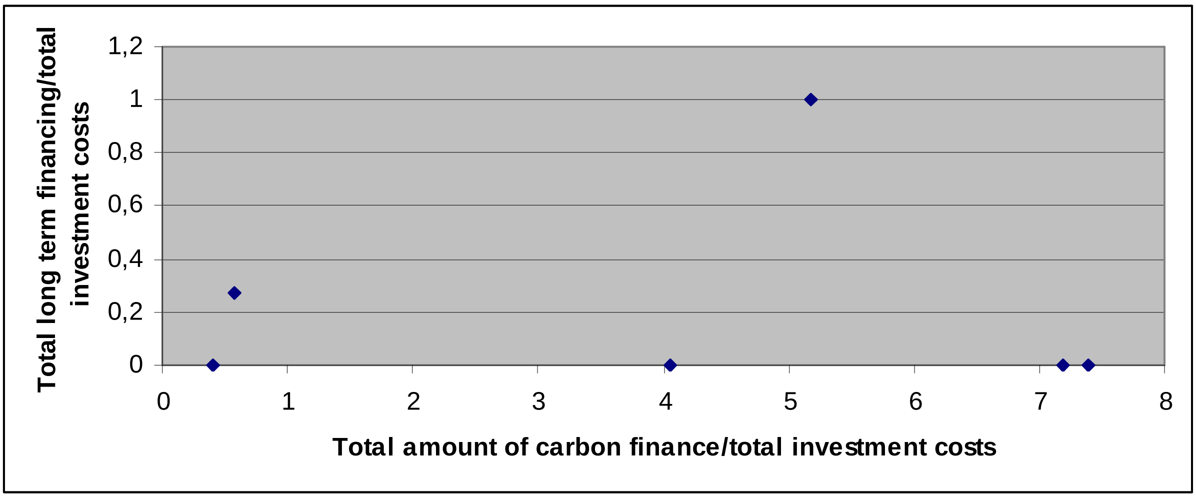


Figure 21: Relationship between carbon finance and long- term investment in social infrastructure



There are two major differences between social and economic infrastructure in this context. For social infrastructure the total amount of carbon finance is in most cases higher than the investment costs and this up to more than 7 times higher. This can be due to the fact that the investment costs are rather low and operating costs more important[17]. For economic infrastructure the total amount of carbon finance never reaches 30% of the overall investment costs. Carbon finance is only an additional revenue for the project (in addition to electricity sales for example). The upfront investment costs of this type of infrastructure are also more important than for social infrastructure.

An interesting observation for economic infrastructure is that generally a higher amount of carbon finance over investment costs is accompanied by a lower amount of long- term financing over total investment costs. At the same time higher carbon revenues (compared to the project's investment costs) are accompanied by relatively higher equity investment by the project promoters.

In this particular portfolio of projects that is available for the present analysis long- term financing seems to be a supplement of those projects where carbon revenues are low. This trend may be explained by the role of the multilateral and bilateral development banks in supporting projects with significant development benefits for the poor countries.

An additional role of the World Bank and its partner bank could be identified if enough data was available, which consists in financing those projects that have external development benefits.

Data on revenues and operating costs of the projects would be needed to deepen the analysis.

It will be also interesting to include explicitly quantified development externalities of the projects in the analysis to see whether these externalities explain better the behaviour of the long- term financiers than the climate change externalities. Furthermore, the impact of carbon finance on long- term project finance can be analysed by comparing these projects with projects financed in the same sectors and countries of the same income groups but that do not benefit from carbon revenues under the Clean Development Mechanism.

6 Conclusion

It has been shown in this paper that carbon revenues linked to the CDM mechanism capture the environmental value added of low CO2-emitting projects, internalise the positive external benefits due to CO2 emission reductions and can render a project financially viable. Theoretically, long- term investors can be attracted if the carbon rent is shared appropriately between the different project partners and incentives to participate in the financing of the project are created. In the face of remaining risks, the World Bank currently plays a role in the financial engineering of the projects by providing risk sharing arrangements for host-country risk, project risk and CDM approval-related risk.

The empirical analysis presented here has shown that long- term capital is provided mainly by local public institutions and bilateral and multilateral banks. These financiers seem to prefer projects in low income countries and provide co-financing especially for those projects with low carbon revenues. This can be interpreted as some prima facie evidence that development banks and local agencies have

[17] Unfortunately no data on operational costs is available for further analysis.

an additional role to play for carbon offset projects in developing countries by co-financing these projects.

For economic infrastructure, two interesting results were found. Long- term financing (as a percentage of investment costs) seems to decrease with an increase in carbon revenues (expressed as a percentage of investment costs). At the same time equity investment seems to increase with increasing carbon revenues. The proposed interpretation is that development banks and local long- term financiers (mostly public sector actors) are capable of assuming a higher degree of risks. They are, hence, able to fill the gap when the provision of carbon revenues, their efficient sharing among the project partners, and risk sharing between these partners, do not allow to attract other long- term financiers (for example from the private sector) or equity investment by the project promoters.

The results of this article are only indicative and preliminary as numerical data on the projects' financing structure are not publicly available for a large enough amount of projects. Furthermore, the dataset used contains especially projects with a strong development component.

For further analysis, more data from more diverse projects is necessary in order to analyse the relationship between the amount of carbon revenues and long- term financing, which can be achieved by the means of more robust econometric methods. It would be especially interesting to analyse more projects where private long and short term financing has been made available.

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