CHAPTER 5

Time – Who Measures What for Whom?

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Abstract

Within environmental finance, the guiding question of "who measures what for whom" can be examined from different angles. In this paper the authors argue that, provided environmental markets are well-designed, measuring environmental performance is very closely related to measuring financial success for the primary actors on the market. Hence, at the aggregate level, market volume can be used as a highly correlated proxy for environmental success. In a second-order interpretation of the guiding question it is, however, revealed that information-related concerns need to go beyond simple measurement issues. It is argued here that transaction costs in the form of information barriers mainly account for inefficiently low levels of environmental finance. The authors explore this information-finance nexus on a actor-by-actor basis in order to identify the general nature of these barriers. From these general considerations, the authors deduce that a part of these transaction costs could be reduced through enabling actors to scale-up overall investments by pooling small-scale projects. In fact, different actors could assume the role of an Information & Technology Broker. Due to limitations in scope, the authors focus their analysis on two of these actors: the Clean Development Mechanism project developers and energy services companies. As it turns out, while seeking to secure project financing, these actors face information related barriers on the supply side. Commercial finance institutions apparently have difficulties to assess the risks associated with environmental small-scale projects, which is due to the lack of an established credit history as well as a deficit in banking expertise for these markets. To overcome such information related barriers, a case for intervention by governments or development finance institutions definitely exists. In this context, all measures fostering a "risk-reduced learning by doing" seem to be particularly promising.

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1 Introduction

According to many scientific sources, it seems quite obvious that global climate change is advancing and that mitigation and adaptation measures are needed in industrialized as well as in developing countries. Necessarily, an increase in energy efficiency (EE) and an increasing share of renewable energies (RE) are the key mitigation measures. Furthermore, it is commonly recognized that these technologies also generate beneficial environmental effects beyond climate change mitigation. Within each category a plethora of technologies is available. However, few of these measures are implemented, which is partly due to a dearth of financial resources. Clearly missing financial resources affect developing countries much more than they affect industrialized countries. Since a large share of greenhouse gas (GHG) emission sources, as well as the potential to increase energy efficiency and the use of renewable energy, stems from developing countries, financing projects in environmental markets in developing countries has high priority. In many cases such projects are small-scale, which generally decreases the chances for third-party financing. In this sense, environmental or "green" finance for developing countries is a topic worthwhile to discuss in detail.

When thinking about environmental or "green" finance, it is important to note that the term does not refer to any deeds of charity by commercial banks; rather, it is clearly driven by the motive of increasing revenues and profits, at least in the longer term. In fact, as other authors in this publication point out, the demand for such financial services stems from markets that are themselves driven by the profit motives of market participants. On such *environmental markets,* environmental externalities are reduced simply because it is rational and profitable for the single actor to do so. This is most obvious on markets that are directly created through environmental regulations, like the international carbon market. This market emerged because a global public good, i.e. greenhouse gas reductions, was privatized through the allocation of tradable emission quotas. The possibility of trading securitized emission credits attributes a value to every tonne of CO_2 equivalent abated, which is referred to as carbon price. It is simply because emission reductions have a value that self-interested actors have an incentive to implement greenhouse gas reduction projects and sell the generated emission offsets on the market.

The same reasoning can be applied to the other environmental markets discussed within this publication, notably the markets for projects in the field of Energy Efficiency and Renewable Energy (EERE). Other contributors to this publication point out that activities on these markets would, in fact, generate positive cash flows and could even be very profitable. One of the major problems with financing such projects is that most investment costs are frontloaded, while returns are realized over a longer term. While this is usually not a problem if financial markets were efficient, certain characteristics of the market for green finance in developing countries significantly hamper the procurement for small-scale projects. Many of the most important market barriers that were identified within the other chapters are informational in nature. As a consequence, the question of "who measures what for whom?" is of particular importance for increasing the levels of financing for small-scale projects on environmental markets.

It is argued below that, when considering such markets, measuring environmental impacts is less of a concern, as these are closely correlated with financial success. Hence, when considering the role of information, the major challenge lies rather in overcoming the informational barriers preventing the implementation of financially viable and environmentally beneficial projects. If market participants face large information-related transaction costs, it is important to identify and strengthen actors that are able—and have an interest in—reducing these barriers. It is in this sense that the above-mentioned question will provide the most valuable answers. Therefore, the focus of the analysis lies on actors that can potentially play such a role of brokering information. As the business models of these actors usually also involve the application of knowledge on available technologies, the authors refer to them as *Information and Technology Brokers*.

This chapter is structured as follows. Following this introductory section, the authors explore the connection between the measurement of environmental improvements and financial success on environmental markets. The most important measurables for the different actors are presented. In section three, the case for enlarging the informational considerations beyond the pure measurement and evaluation concerns is established. The authors further present an overview of different information barriers on environmental markets structured by actors, which will serve as reference to the more detailed explorations that follow. The focus lies on actors that can fulfil the role of an Information and Technology Broker. In section 4, the authors present the information-finance nexus in the context of the CDM and examine to what extent the project developer could assume the brokerage role. Special emphasis is laid on small-scale and programmatic CDM. Section 5 discusses the role of energy service companies in scaling-up EERE investments. The paper concludes with section 6.

2 Measuring Environmental Impact and Financial Success

If environmental markets are to be a successful instrument for environmental policy, environmental improvements and expected gains for market participants need to be closely correlated. With respect to the markets considered by other authors within this publication, this is indeed the case. The primary focus of this publication is small-scale projects in the fields of energy Efficiency and Renewable Energy (EERE), as well as the generation of greenhouse gas offsets.

While the connection of carbon offsets to an environmental policy goal is straightforward, EERE measures might be considered as only indirectly related to environmental concerns. It is true that the motivation for fostering such markets might also be based on other policy goals, like the reduction in dependency of a country's economy on oil imports. However, insofar as EERE contributes to the reduction of fossil fuel use for energy production, such projects obviously have environmentally beneficial effects, such as reductions in emission of CO_2, NO_x, SO_2, and volatile organic compounds. In those cases where EERE projects contribute to a reduction in dependency on nuclear energy, the beneficial environmental effects are the reduction in nuclear waste and risks of radiation due to unforeseeable leakages or catastrophic events. Hence the environmental goal underlying the policies promoting EERE technologies is usually measured in energy units produced through non-renewable sources. Given this goal, the direct relationship between environmental improvements and the profit motive on this market is quite obvious. While energy savings or installation of renewable energy capacity are primarily striven for by market actors because of their financial gains, these gains translate into actions to achieve an environmental goal.

In both the EERE market and the market for carbon offsets—which are to a large extent overlapping—the connection between environmental improvements measured in KWh/GWh and tonnes of CO_2 equivalents and financial gains is very close. In fact, the financial gains of such projects are determined by multiplying the respective amounts by the market price—i.e. the price per energy unit or the price per carbon certificate—reduced by the investments costs. In fact, this close connection lies at the heart of the general idea of environmental markets. As a consequence, measuring financial success is closely correlated with measuring environmental improvements. In the logic of environmental markets the general answer to the question of "who measures what for whom" is, at least in principle, very simple: every market participant measures for himself what is in his interest to measure. As the major environmental variables on these markets are directly accounted for in the actors' calculations of expected and actual cash flows, the major case for monitoring and evaluation lies rather within a thoughtful design of environmental markets.

The problem of environmental market design is most imminent in those markets which are entirely created through regulation, like the Kyoto carbon markets. The demand for the good traded on these markets, i.e. offsets for greenhouse gas emissions, crucially depends on the stringency of the emission targets for industrialized countries which are defined within the international climate policy negotiations. The only—yet important—instrument that connects the developing countries to this market is the Clean Development Mechanism (CDM). This mechanism allows for the implementation of projects involving greenhouse gas reductions,[1] which can be sold on the carbon market in form of Certified Emission Reductions (CERs). Each of these certificates represents an offset of one metric tonne of CO_2 equivalents. On the Kyoto marketplace these certificates, and certificates stemming from other Kyoto markets, are perfectly fungible, which raises the question of how well these certificates represent *actual* emission reductions.

[1] In fact, the CDM also allows for projects aiming for temporary absorption of CO_2 through afforestation or reforestation. The market volume of such project is, however, currently rather small.

This problem is being addressed through the Kyoto rules, which are to guarantee that the certified reductions would not have occurred without the financial leverage provided by the possibility to sell the certificates. The general principle, referred to as *additionality*, is addressed through methods applied for the calculation of overall project offsets. The project designer needs to establish a "business as usual" scenario, referred to as the baseline, depicting the emission levels that would have occurred if the project were not implemented. The number of certificates generated by a CDM project is then determined by the difference between the baseline emissions and the actual emissions still occurring under the project.

In order to reduce opportunistic misrepresentation of either the baseline or the actual project emissions, the CDM is subject to a tight regulatory framework. The project details must be thoroughly disclosed, while baseline and actual emissions are subject to third party verification. In order to reduce problems of collusion, the regulator—the role of which is mainly taken up by the CDM executive board in Bonn, Germany—is to execute regular spot checks within the set of all admitted CDM projects. The overall process for project admission is hence associated with significant transaction costs and is particularly time consuming.[2] What is important in the context addressed here, however, is the fact that all issues of measurement, monitoring and verification of carbon offsets are addressed within this CDM regulatory process. Hence, once a project is registered and certificates for greenhouse gas reductions are issued, the CDM market is not different from any other market on which standardized goods are traded.

In summary, the answer to the question of "who measures what for whom" is, as far as the CDM is concerned, meticulously defined within the Kyoto rules. As a legal claim for CDM certificates can only be established if these rules are followed, the general logic laid out above should apply: Every actor measures what is in his interest to measure. It is to note, however, that the CDM is a market entirely built from scratch. This means that all actors involved, particularly the regulators, need to learn how to best operationalize this general logic within the implementation of the mechanism. Addressing these issues would, however, require going into a level of detail which is beyond the scope of this paper.

The general statement that on environmental markets, every actor only measures those variables that are important for his own decision making raises the question of what in fact those objective variables might be. As to the primary market participants, the answer is straightforward. Provided an appropriate market design, buyers and sellers of privatized environmental goods only need to measure their own financial performance in order to foster environmental improvements. The same argument can be applied to commercial finance institutions that are to provide financing vehicles to these markets. Actors like governments or development finance institutions (DFIs), however, first need to define an objective to be achieved through potential interventions. In general, it can be rightfully assumed

2 According to Fenhann (2008a), depending on the ex ante verification cycle it may take up to three years or more until a CDM project is registered.

that these institutions want to foster environmental improvements. The measurement of success for such intervention intended to achieve this goal is rather unproblematic. Due to the close relationship between such improvements and overall market volume, the latter can easily be used as a signal for the former.

An example of this reasoning is depicted in Figure 1, representing the results from the Hungary Energy Efficiency Co-Finance Program (HEECP). This programme was headed by the IFC using GEF and IFC funds. The basic instrument used was a financial guarantee mechanism that, in cooperation with local finance institutions, aimed at building up sustainable commercial lending business for energy efficiency investment across a range of sectors. The graphic showcases that, in principle, measurement of DFI's impact on environmental finance markets is straightforward. The measurement variable of interest is, given the aim of increase in overall credit, the amount of investment triggered by the guarantee programme. The figure shows that the programme yielded a significant leverage effect, which should be at the basis of any guarantee instrument.[3]

Concluding these considerations, it can be stated that carefully designed environmental markets render the measurement of environmental improvements rather unproblematic. The problems here lie rather in the actual design of the regulatory framework than in the measurement itself, as the publicly observable data on market volumes are closely correlated with environmental improvements. If the logic

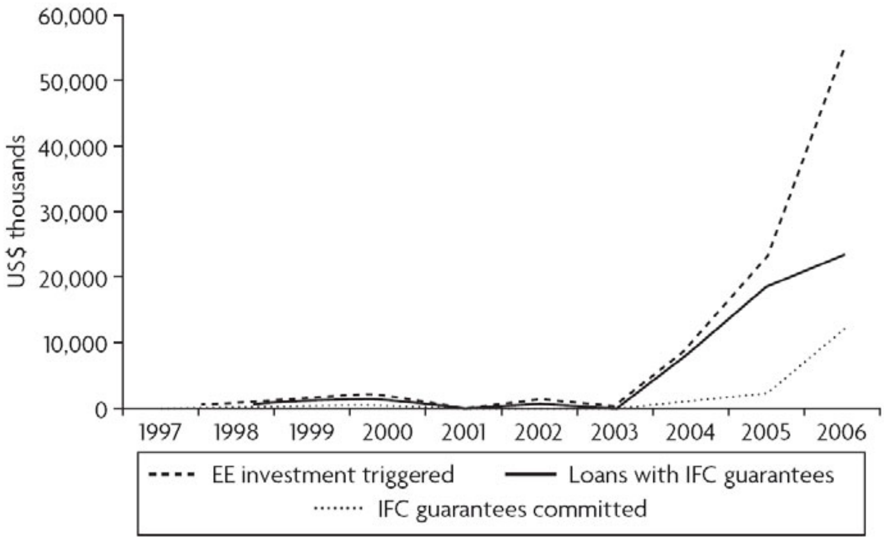

Fig. 1. Results from the HEEPC, 1997–2006

Source: World Bank (2008)

3 World Bank (2008).

of environmental markets applies, it is sufficient that every actor evaluates those data that are needed to measure and improve his financial performance. This, in turn, facilitates the measurement of success for institutions interested in further developing markets, like governments or development banks. The base variable of evaluation for these actors is the increase in market volume that is attributable to the measure applied.

However, the question of "who measures what for whom" goes in fact deeper than a simple identification of measurables for success with respect to these markets. In fact, the question addresses, at least implicitly, the fact that one of the major areas of necessary intervention lies within the area of information flows. In the following, the implications of such a "second-degree" interpretation of the guiding question will be addressed in more detail.

3 Information and Green Markets – An Overview

Any sensible use of the term environmental finance, in its meaning of a market for financial services related to markets for environmental goods, presupposes that the latter already exist. Hence, considering financing for environmental markets that might be created in the future, for example a market for biodiversity, might be interesting but is beyond the scope of the topic discussed here. It goes without saying that the creation of such markets is not within the responsibility of financial institutions, but—insofar as they result from regulation—a task for countries' sovereigns. Any other actor on potential or actual environmental markets has to take the regulatory framework as given. The following considerations are therefore limited to the markets that were already introduced, notably the carbon market, and markets for energy efficiency and renewable energy (EERE). The discussion is further restricted here to what is generally referred to as small-scale projects in developing countries, which are usually associated with households, SMEs, and municipalities.

It has been emphasized within the other chapters that lack of knowledge and other informational barriers are among the key problems in environmental finance markets. These barriers represent simply the costs of collecting and processing the information required to take an objectively rational investment decision. As many actors perceive—rightfully or not—these costs as being too high, the level of small-scale projects on environmental markets is inefficiently low. Reducing these costs would surely not solve all problems present on the market for environmental finance,[4] but most likely result in a significant increase in investment.

When considering the role of information on environmental finance markets, it is necessary to recognise that the information-related challenges vary among the

[4] Clearly, if inefficiencies on financial markets hamper the financing of lucrative projects, measures for general financial market development will also increase the availability of financial vehicles for activities on green markets.

key actors on these markets. The relative underinvestment on environmental markets is also a result of the interaction of all these informational shortcomings. In order to discuss the information-related barriers in these markets in a systematic manner, it is useful to reduce the complexity of these interactions in an analytical framework. A graphical representation of such a reduction is given in Figure 2. This figure represents the key actors on environmental finance markets and their most important information needs. The actors themselves are interconnected through information flows; these flows can be hampered by barriers, also indicated in the figure. Development finance institutions and entities referred to as Information & Technology Brokers can act as catalysers in order to overcome these information barriers. In the following, the information-finance nexus on environmental markets is addressed on an actor-by-actor basis.

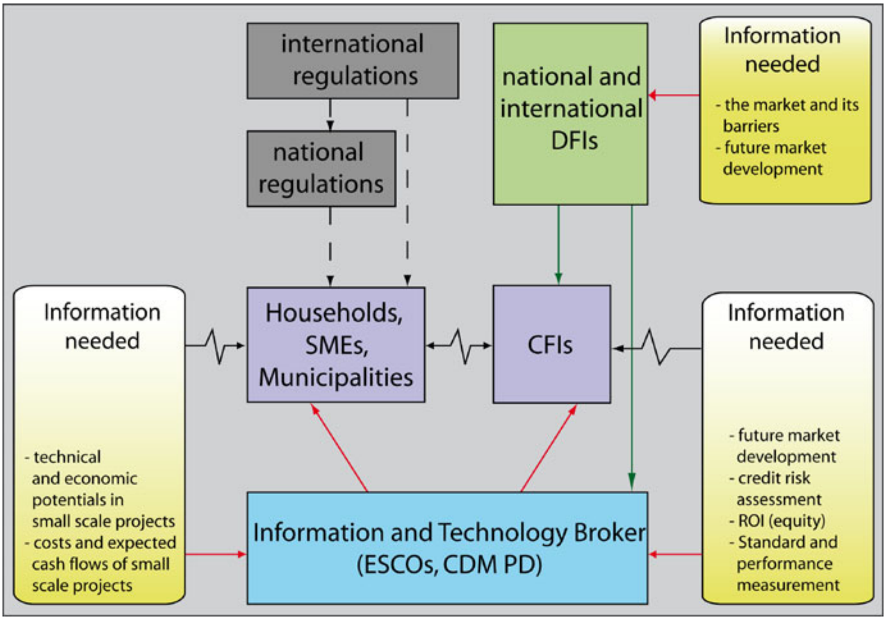

Fig. 2. Actors and Information Barriers in Environmental Markets

3.1 Households, SMEs and Municipalities

In principle, the beneficiaries from small-scale investments in environmental markets are the end-users themselves. According to the scope defined above, these consist of households, SMEs, and municipalities. In the logic of environmental markets, where actors pursuing their self-interest yield environmental improvements, these actors should have an incentive to implement such projects by themselves. As is amply discussed within the other chapters, this is apparently not the case. The fact that there still exist "big bills left on the sidewalk" is often attributed to irrational decision making. Another explanation, favoured by many economists, is the existence of information barriers. The most apparent barrier preventing investments on the markets considered here is simply a lack of awareness of the existence of potentials for savings or additional earnings. End-users are often unaware of the existence of better technologies, the associated improvements in cash flows, or the possibilities of tax rebates and subsidies that are available. The latter is of particular importance for poorer households, which are—without substantial support—rather preoccupied with improving their living conditions in the short term. A similar argument is often brought forward with respect to small enterprises, which tend to prefer investing their limited resources in upgrades of equipment which is directly related to production. But even where the existence of potential government support is known, the actual procedures of tax rebate or subsidy schemes are often considered to be too bureaucratic and time consuming. Furthermore, the energy and cost saving possibilities of a single project or site are usually small compared to the transaction costs, which are not directly related to information, like negotiation or contracting costs. This is particularly evident in the residential sector when ownership of buildings is shared by several private owners.[5]

It is probable that the persistence of end-user information barriers stems in many cases from the fact that these actors remain rationally uninformed. If the potential gains from projects are smaller than the costs for arranging government support and all other cost to be incurred prior to project implementation, it is perfectly rational to remain uninformed on these matters. The most promising way to overcome this problem is to search for potential aggregators that incur the fix cost of information gathering just once and implement a plethora of small-scale projects. This role is sometimes taken up by municipalities, which can not only implement EERE projects within their own facilities, but are also able to set up programmes for supporting small-scale projects within their constituency. This has been, for example, the case in the Kuyasa low-cost urban housing upgrade project, presented in section 4.3, where the city of Cape Town has played a vital role as intermediary.

It is often pointed out that the reluctance of implementing small-scale projects is also due to the fact that decision makers tend to apply initially very high but decreasing discount rates within individual decisions. This explanation for the lack in investment in EERE is quite plausible, as it is backed by ample evidence of such hyperbolic discounting in individual decision-making.[6] However, the existence of high discount rates alone cannot fully explain the relative lack of investment. If

5 WEC (2008); the shared ownership in the residential sector also features a plethora of information asymmetries that hamper investments in energy efficiency. A profound analysis of these can be found in IEA (2008).

6 See, for example, Benzion et al. (1989), or Epper et al. (2008).

end-users discount future revenues from EERE investments with rates above the interest rates, other market participants are able to yield significant gains from arbitrage. As financial institutions can refinance at market interest rates lying way below the observed individual time preferences, the overall amount of finance procured would have to be significantly larger than actually observed. This hints to the fact that not only the primary environmental markets but also the associated market for project-finance are subject to significant information barriers, as will be shortly recapitulated in the following.

3.2 Commercial Finance Institutions (CFIs)

As already pointed out in the introduction, the principles of environmental finance are not different from standard project finance. Just as any other investment project, EERE investments and greenhouse gas reduction projects are characterized by the fact that a large part of the costs are incurred in the start-up phase, while revenue streams can be only expected in the longer term. Consequently, the financing needs in environmental markets are in principle not different from what commercial finance institutions are familiar with. Environmental projects need upfront financing which—on average—can be expected to be paid back at later points in time. Still, there is a significant underprovision of environmental finance, which is the guiding theme of this publication. While the lack of demand for such services, discussed above, is a reason for low levels of project finance, a significant part of the problem can be explained by taking a closer look at the supply side.

Market observers often point out that financing environmental projects is associated with large risks, for which reason commercial banks refrain from procuring services to this market. This is not necessarily true for all cases considered here, as the revenue streams from energy savings or GHG reductions might be more secure than from other investments. It is, however, quite plausible that default risks are significantly high in the small-scale context as the collaterals procured by the end-users are limited. Still, given that the main business of CFIs consists of pooling risks over a wide customer base, a large variance alone cannot explain the general reluctance for financing potentially lucrative projects.

It is likely that the actual reason for the lack of financing lies not directly with the level of the objective risks associated with environmental projects, but rather with the difficulty to assess those risks. As the concept of environmental markets is quite new, CFIs generally lack financing expertise in this area. In order to assess the associated risks properly, a credit history would be necessary, which still needs to be generated. Under these circumstances, it is understandable that CFIs by themselves will only provide finance to customers with high levels of creditworthiness. However, if green finance is to take off in the longer term, CFIs need to build up expertise in assessing technologies used, savings and earnings that can be expected, etc. Observers also point out that CFIs lack a general understanding of the drivers of important markets in this area, such as the international carbon market.[7] As will be argued in the following sections, the additional risks associated with such projects are in general manageable if sufficient information is provided.

A specific problem in the context of environmental finance and associated transaction costs is investments of the smallest scale, like simple insulation projects in the residential sector. In such cases, it is likely that the costs of negotiating the financing terms exceed the gains from the project. Such transaction costs can, again, only be lowered through a bundling of smallest-scale projects by an institution acting as an aggregator, like the Information and Technology Brokers addressed below.

3.3 Governments and Development Finance Institutions (DFIs)

While it is within the logic of environmental markets that most actors are driven by self-interest, this should necessarily not be the case for those actors who are supposed to set the framework conditions and to facilitate the start-up phase of markets. The most important actors in this area are international regulators of the carbon market, national governments and development finance institutions. While international regulators exclusively concentrate on setting and enforcing the general rules applicable to the carbon market, governments and DFIs also interact more directly with the primary market participants.

Government policies might either increase or decrease the incentive to engage in environmental markets. A prominent example for a decrease in incentives is the case of the often-quoted "perverse" subsidies for carbon- and energy-intensive technologies. In general, however, national governments seem to have an interest in fostering environmental markets. Many countries have implemented tax rebates or subsidy schemes for EERE measures. Further instruments that are applied are grants for R&D, the implementation of pilot projects, and the procurement of soft loan schemes. An important tool for reducing information barriers is, for example, the introduction of an energy audit scheme. Important information on the average benefits and costs of EERE measures can be derived from such energy audits. These can be used as a building block for assessing risks and opportunities in environmental finance.[8]

Development Finance Institutions play a prominent role in the overall information-related setup discussed here. For example, development banks can, in their role of government advisor, provide valuable information on best practices with respect to the markets' framework conditions. More importantly, due to their close relationship with the financial market, DFIs can help to directly reduce the information barriers that hamper the development of a self-sustaining environmental finance market. One important instrument is to directly enhance the information

[7] See for example Capoor and Ambrosi (2007) or Figueres and Philips (2007).

[8] WEC (2008).

base of commercial finance institutions through capacity building. Spreading knowledge on the main drivers of environmental markets will directly improve commercial banks' capacity to assess risks accurately and to develop appropriate financing vehicles.

In addition to direct measures for capacity building, DFIs can reduce information barriers by applying instruments of "risk-reduced learning by doing". This class of instruments includes loan guarantees, credit subsides, grants, etc. The general idea is that DFIs directly or indirectly assume part of the credit risk, while commercial banks can build up a credit history under acceptable conditions. These instruments accordingly lay the basis for a more informed risk assessment in the future and increase the expertise of commercial banks in new markets, where they would otherwise not be engaged. However, if such markets are supposed to be self-sustaining, in the future such programmes would need to be of limited duration. In this respect they differ from programmes based on the motives of poverty reduction or other social policy goals.

A successful scale-up through capacity building requires that DFIs build up and spread knowledge on these markets within their own institutional borders. This is an ongoing process, far from being completed, as is shown by the example of the mainstreaming of carbon pricing within those institutions. While development banks were among the first investors in the early years of the Clean Development Mechanism, it is within many of the banks' activities still not taken into account that greenhouse gas emissions are associated with shadow prices. As a recent study by the World Resources Institute points out, the partner country strategies vary widely with respect to the integration of concerns on climate change.[9] The author of this study examines the level of mainstreaming of climate change within four major DFIs. An aggregation of the results of this study is presented in Figure 3, categorizing recent energy-related investments of the World Bank, the International Finance Corporation (IFC), the Asian Development Bank (ADB), and the Inter-American Development Bank (IDB). The total of energy related investments are split up among three different groups defined by the author of the WRI study, namely activities that integrate, mention, and ignore climate change. It is quite obvious that, at least until 2006, mainstreaming of climate change issues was not very advanced within the DFIs. This can be partly explained by the fact that DFIs' strategies were slanted towards supporting few large-scale projects. Investments in renewable energy are often associated with smaller projects and therefore require a lower proportion of DFIs' resources. The most recent development depicted might discern a rethinking in DFI strategies. The 2007 increase in considering climate change might also be a result of the topic's increased media coverage within that year. The years to come will show if the learning process will endure in the longer term.

[9] WRI (2008).

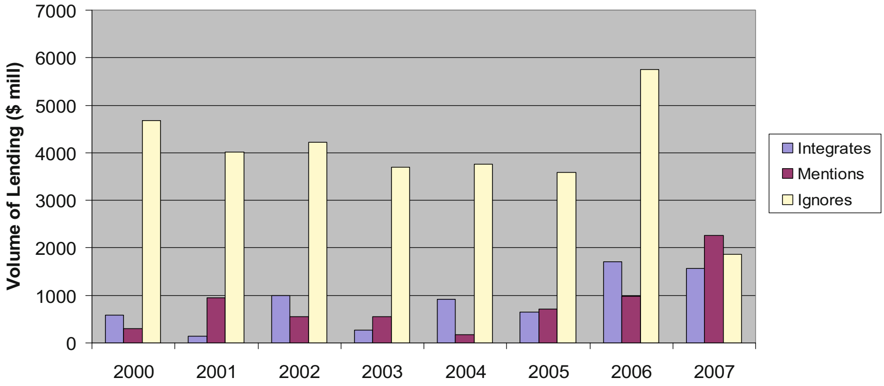

Fig. 3. Shares of Energy Investments by four major DFIs considering Climate Change

Source: Own aggregation based on WRI (2008), Climate Change at the Multilateral Development Banks

As the above-mentioned research by the World Resources Institute showcases, there definitely exists a case for measurement and evaluation with respect to mainstreaming the idea of environmental markets within DFIs. The introduction of a systematic greenhouse gas accounting for DFI-supported projects would provide further insights in future reduction potentials. The calculated project carbon footprints could further be used for a more holistic cost-benefit analysis for such projects, including external costs with respect to climate change. Within such an analysis the associated greenhouse gas emissions could either be valued at the current carbon price, or the value could be constructed based on theoretical considerations on the social cost of carbon, as used, for example, within the Stern Review.

3.4 Information and Technology Brokers on Environmental Markets

While programmes aiming at enhancing the expertise within CFIs are likely to increase the supply side of environmental finance markets, fostering the demand for such financing vehicles would require overcoming the large information and transaction costs associated with this side of the market. One promising approach is to support information and technology brokers, following the business model of pooling small-scale projects into a larger-scale programme in order to participate in the financial gains. Clearly, supporting these aggregators is only one of many strategies that DFIs or governments can apply in order to increase demand in environmental finance. However, given that this approach seems to be promising, it surely deserves to be considered in more detail.

Given the above-exposed logic of environmental markets, when searching for potential project aggregators it is natural to look for actors that pool and implement small-scale projects out of self-interest. If projects were lucrative with respect to their production costs, but hampered by informational and other transaction costs, actors capable of achieving sufficient economies of scale would still have an incentive to implement such projects in the long run without further government support. In order to achieve financially viable scale-ups, an institution acting as an aggregator would have to build up knowledge in different fields. First and foremost, acquiring expertise in the economic and technical potentials of different investments in EERE and carbon reductions is a precondition for any viable bundling of small-scale projects. Second, an effective aggregator needs to know about potential government support and the possibilities of financing or refinancing the front-loaded fraction of the investments. In most cases the business concept of the aggregator will not be limited to the provision of this information, but will also include the actual implementation of the project, including the installation, monitoring and maintenance of the project technology. For this reason we will refer to this class of actors as Information & Technology Brokers.

An effective Information & Technology Broker acting along these lines would not only decrease transaction costs on the demand side of environmental finance: the emergence of such actors can also effectively reduce information problems on the supply side. It can be reasonably assumed that companies procuring I&T brokering have already gathered the information necessary for assessing the risks associated with potential future earnings. This information could easily feed into the decisions of risk capital providers as well as outside creditors. Furthermore, bundling small-scale projects has the interesting side effect that the I&T Broker has already diversified default risks. Furthermore, an Information & Technology Broker is capable of negotiating standardized financing conditions on behalf of the end-users or directly providing them with upfront funding while refinancing his business through more standardized products. In both cases finance-related transactions costs are reduced as well.

Several institutions at least in part assuming the role of an I&T Broker are discussed within other chapters of this publication. Depending on what market is considered, municipalities, Energy Service Companies (ESCOs), CDM project developers, or sometimes even utilities can fulfil the functions of such an aggregator. However, while the idea of an I&T Broker is theoretically appealing, actors that actually take up such a role in the real world still face significant barriers to the financial market. Those barriers are, in principle, not different from those discussed in the context of the financing supply side in general. Owing to a lack of expertise in environmental markets, CFIs have apparent problems in understanding the business model underlying I&T Brokers. This problem is further increased by the lack of a "track record", which is fundamental for a bank's risk assessment. As a consequence, CFIs are very reluctant in providing finance to those I&T Brokers that cannot provide a significant amount of collateral.

While the general overview on information problems attempted within the previous pages is useful for understanding the interrelationships between information and environmental finance, this level of generality lends itself to draw only very rough conclusions. Any detailed discussion of measures to potentially overcome the numerous information problems is beyond the restricted scope of this paper. In order to still be able to discuss the information-financing nexus on a more detailed level, the following analysis concentrates on two classes of actors that could help to overcome informational problems: CDM project developers and ESCOs. This choice is not to be interpreted as being the only field in the nexus that might represent a case for government or DFI intervention. It is rather one of many of such cases. However, given the necessity of scaling up small-scale activities, supporting these actors seems particularly promising.

4 Case 1: CDM and the Project Developer as I&T Broker

As already mentioned, the international climate policy framework includes a sophisticated system of emissions trading for greenhouse gases (GHGs), consisting of several different sub-markets including cap-and-trade as well as project-based mechanisms. This international carbon market has been fully operational since the beginning of the first commitment period of the Kyoto Protocol in 2008. Currently, the only mechanism that links developing countries and their enormous GHG reduction potentials to the worldwide carbon market is the Clean Development Mechanism. The general idea of the CDM is to incentivize GHG reduction or sink projects within developing countries that are financed by parties from industrialized countries by securitizing the offsets achieved within the project, which are then tradable on the carbon market. The GHG offsets achievable within the CDM are considerable. For the first commitment period of the Kyoto Protocol from 2008 to 2012, the estimates of the primary market volume range from 1.5 to 3 billion metric tonnes of CO_2-equivalents.[10] Projections on the long term development of the CDM certificate price are a difficult endeavour, as the price depends also on several political decisions. The spot price on the secondary market for CDM certificates fluctuated in October 2008 between EUR 18 and 20 per tonne CO_2-equivalent.[11]

Initially, the underlying idea of the CDM was that an investor from an industrial country provides the financing (and sometimes the implemented technology) to a project developer situated within a developing country. The latter was to implement and operate the project activity, while the investor was still actively involved in the actual operations by procuring the necessary technical know-how. Within the actual implementation of the mechanism, however, a different organisational structure became predominant, the so-called Emission Reduction Purchase Agreement (ERPA). While the simple buyer-seller structure of the purchase contract provides the market participants with the necessary flexibility that is needed in a newly created market, it has significantly altered the perception of

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[10] See Fenhann (2008a), PointCarbon (2008a), and UNFCCC (2008).

[11] PointCarbon (2008b).

responsibilities for the actual investments necessary within the CDM. In most implemented CDM projects, the industrialized country party does not represent an investor providing up-front finance for implementing the project, but simply acts as a buyer for the certificates generated by the project. While a purchase contract could, in principle, also include a fixed price component paid up front, including such payments in advance is rather the exception for currently implemented projects involving private sector buyers.[12] Hence, for most CDM projects the financial influx from the buyer's side is reduced to the per unit payment upon delivery of the certificates. As a consequence, if third-party financing vehicles were unavailable the seller would take on all project-related risks. As these risks are particularly important for the availability and type of third-party financing, they are discussed below.

4.1 Risks

Like any other transboundary market, trading in CDM certificates is associated with currency risks, host country risks, off-take risks, and several other risk types. However, the fact that the CDM is a market entirely created through regulation entails several risks specific to that market. For example, there exists genuine uncertainty among market participants about the continuation of the international climate policy regime after 2012. This risk has generally been dealt with by almost exclusively implementing projects which break even within the first commitment period of the Kyoto Protocol. While this regulatory uncertainty hampers the implementation of projects which would be environmentally beneficial in the longer term, resolving this uncertainty is a task for governments and their climate policy negotiators. Market participants have to take this uncertainty as given. Another regulatory risk is that a project might not be recognized as being valid within the CDM and hence fail to be registered. As mentioned in section two, projects have to pass through a complicated and time-consuming regulatory process in order to be accepted within the CDM. Based on the experiences with projects that have been evaluated within this process, Fenhann (2008a) estimates that the probability of project rejection by the regulator is about 5%.[13]

Once the project is registered within the CDM, the associated risks are, in principle, the same as within standard project finance in developing countries. First, there might the standard default risk that the product to be delivered—carbon offsets—cannot be produced.[14] In this respect CDM certificates are not different from

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[12] Capoor and Ambrosi (2007), see also Capoor and Ambrosi (2008).

[13] Note that Projects in earlier stages of the CDM cycle face in addition a probability of 18.5% of not being registered. (Fenhann (2008a)).

[14] One specificity here is the fact that CDM credits are only being issued if the emission reductions are verified by a third-party verifier. There exist hence, risks associated with monitoring and verification. (See also section 2).

any other product. Due to any imaginable contingency the project might simply fail to produce the expected amount of deliverables. Furthermore, CDM projects can also suffer from risks which are associated with the uncertainty of future market prices for carbon credits. While such sales risks do, in general, occur on any market, the drivers of these risks might be different within the CDM, as they are mainly of political or regulatory nature. For example, risks might include that regulatory rules determining the scarcity of carbon emission rights change (e.g. the so-called EU ETS risk and Post-Kyoto risk) or that the necessary infrastructure for carbon trading is not yet established within specific buyer countries (ITL risk).[15] It is foreseeable that with the further development of the international climate policy framework both of these risks will diminish or even disappear. Generally, it can be observed that in sum the production and sales risks are quantifiable. As Fenhann (2008b) reports, the probability of a successful issuance is about 96.3% for projects registered within the CDM. The average risk premium for these risks on the forward market ranges—depending on the project type—between EUR 2 and 5 per tonne of CO_2 equivalent.[16]

In summary, as far as the associated risks are concerned, financing CDM projects does, in principle, not differ from standard project finance. However, there exist some particularities to the CDM which require a diligent assessment. Importantly, CDM-specific risks are generally quantifiable and hence manageable, provided the required knowledge base is established.

4.2 The Challenge for Financial Institutions

Given the specificities of the CDM market, there exists not only a large need, but also a lucrative potential, for financial services in this market. There is an urgent need for financial vehicles that allow the future cash flow from certificate sales to be frontloaded and used for project investments. In principle, such vehicles could involve both equity as well as debt finance. A growing number of "carbon funds" provide equity finance for CDM projects, while pooling the risks over a large portfolio of projects. Cochran and Leguet (2007) estimate that in 2007 EUR 7 billion was invested in 58 carbon funds; they project an increase up to EUR 9.4 billion of total fund capitalization in 2008. While in the "trial phase" of the CDM from 2000 to 2005, these funds were mainly operated by development finance institutions and governments, the recent increase in projects financed by carbon funds is to the largest part attributable to private sector engagement (see Figure 4). This development is an example of DFIs' successful pioneering in the field of green finance.

[15] For further reading on the different risks associated with the CDM, see UNEP RISOE (2007).

[16] According to PointCarbon (2008a), in 2007 issued CERs fetched between EUR 14 and 17, while forward prices on CERs from registered projects yielded EUR 12 on average. This is in line with the observations by Capoor and Ambrosi (2008), who present evidence for an issuance risk premium of about EUR 3.

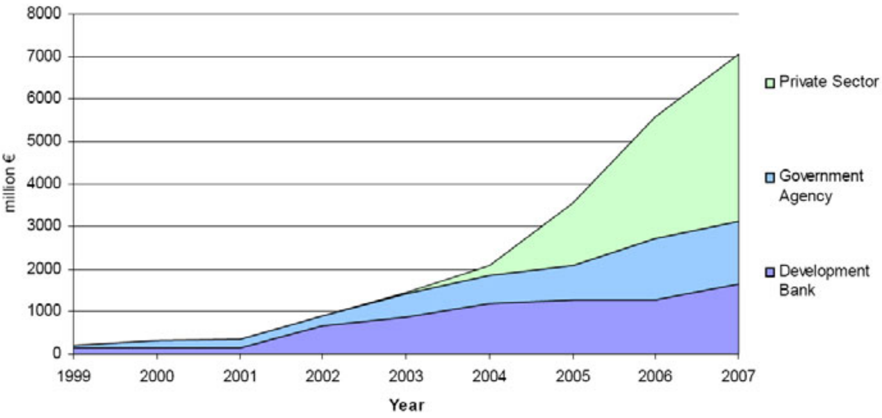

Fig. 4. Evolution of CDM Investment Capital by Vehicle Managing Agent

Source: Cochran and Leguet (2007)

However, in light of the fact that CDM risks are quite manageable, there exists a priori no reason why part of the financing of CDM projects should not be taken over by outside creditors. While there are a few examples of CDM projects partly financed by loans from large international banks, CFIs in developing countries still seem reluctant to enter this market. One of the major reasons for this reluctance is the fact that assessing the risks associated with CDM projects requires a significant amount of knowledge on the project activity as well as a deep understanding of the specificities of the carbon market. Thus, it is likely that with a maturing of the market the amount of debt financing will further increase. However, there may be a case for DFI intervention in this specific market based on the above-depicted reasoning of "risk-reduced learning by doing". In order to generate such an experience base for reluctant CFIs in specific countries, DFIs might intervene by taking over a part of the credit risk through grants or by subsidizing interest over a limited time period. A further reduction of financial market barriers induced by lack of knowledge is likely to significantly foster the CDM's environmental effectiveness while at the same time tapping its potential to contribute to sustainable development.

4.3 Small-Scale Projects and the Potential of Programmatic CDM

The Clean Development Mechanism is often misperceived as being only capable of incentivizing large-scale projects. This is not surprising, as the implementation of large-scale projects, like those involving geo-thermal or tidal power generation, is usually well covered by the media. Furthermore, the CDM accreditation process clearly entails significant transaction costs; therefore, only projects of a certain size become financially viable within the mechanism. However, the Kyoto rules also provide for simpler procedures concerning small-scale projects.[17] A closer look at the CDM project pipeline, which includes all projects currently registered or under review, reveals that implementing such small-scale projects within the CDM is quite popular. As of May 2008, 1462 projects in the pipeline, i.e. 44% of all projects, were small-scale.[18]

To be eligible as a CDM small-scale project, the respective project should not exceed specific thresholds. For example, the reduction in energy consumption attributable to the project activity should not exceed 15 GWh per year.[19] Hence, for energy-intensive SMEs or municipalities, small-scale CDM might be a lucrative option to leverage investments in EERE. Projects on the level of single households would be, however, not financially viable, as the transaction costs associated with the mechanism would far exceed the potential gains from the project. There exists, however, the possibility to pool EERE activities in many different households into one single CDM project. It is in this respect that an ingenious CDM project developer can become an I&T-Broker.

A good example for such a pooling of household activities into a small-scale CDM project is the *Kuyasa low-cost urban housing upgrade project*, in Cape Town, South Africa. This project involves EERE upgrades within a low-income housing settlement in Khayelitsha, a township located on the south-eastern side of the City of Cape Town. The project activity consists of retrofitting 2309 state-subsidised $30m^2$ housing units with three simple EERE measures: the installation of solar water heaters, insulated ceilings and compact fluorescent light bulbs. These measures are generating reductions in CO_2 emissions of about 2.85 tonnes per household per year. The total project reduction is approximately 6,580 tonnes of CO_2 equivalents per annum. As these effects are estimated to accumulate over a 21 year period, the overall impact on emissions is considerable. The savings in energy costs for a single household are estimated to be approximately ZAR 625.84 (USD 63) per year. The measures are further expected to reduce health costs by approximately ZAR 685 (USD 69) per household per annum.[20]

The above example showcases that the pooling of project activities at the household level is already possible under the standard CDM rules for small-scale projects. However, given that the number of household participating must be known before the start of the project, these rules certainly have some limitations to trigger wide-spread EERE measures in developing countries. For this reason, a new set of rules has been added recently to the CDM framework allowing for Programmes of

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[17] See UNFCCC(2002), Decision 17 and Annex.

[18] See Fenhann (2008c).

[19] Further criteria for eligibility under the CDM small-scale regime are reductions in energy consumption below 15 GWh/year, and emission reductions of less than 15 kilo tonnes of CO_2 equivalents. See UNFCCC(2002), decision 17, §6(c).

[20] See CDM PDD (2005) and SouthSouthNorth (2005).

Activities (PoA).[21] These rules open the possibility to register an unlimited number of CDM project activities under a single CDM programme. A Programme of Activities may be coordinated by a public or private entity and, in principle, may include any voluntary sets of measures that result in additional emission reductions. Given the novelty of the instrument, by 1 November 2008, only five PoAs were under CDM validation. These programmes involve: home solar systems in Bangladesh, biodigesters in small pork farms in Brazil, solar water heaters in South Africa, Compact Fluorescent Lights in Mexico, and municipal waste composting in Uganda. The difference in technologies used within these different programmes is an indication of the large potential for triggering small-scale EERE investments that rests within future CDM PoA implementations.[22] Another advantage is that the income from PoAs, which is generated through certificate sales, can be easily channelled back to the end-users, either through consumer credits for individual purchases of household appliances, or for SMEs through microfinancing structures for enterprise development.

Many observers of the CDM have pointed out that the procedural and methodological CDM rules need refinement in order to reduce the hurdles impeding the development of PoAs. In this context, the importance of information generation for scaling-up environmental markets is once again quite obvious. Given that regulators, like market participants, are still in a learning phase, the rules for the mechanisms are sequentially adjusted. These adjustments are based on regular 'calls for input' generating useful feedback by the market participants. As to the further development of the PoA rules, the early lessons will be discussed and incorporated at the next meetings of the parties of the Kyoto Protocol in Posnan, Poland and Copenhagen, Denmark.

Pooling of CDM projects within small-scale rules and PoAs encounter the same barriers to project financing vehicles as CDM projects in general. In many PoAs, the sales of certificates will be the only cash income (e.g. with energy efficiency measures). This exacerbates the above-described problem of front-loaded implementation costs and cash flows occurring only at a later time. As Figueres and Philips (2007) point out, few financial institutions are willing to absorb the corresponding risk, as risk assessment for new instruments which lack a credit history is always difficult. Hence, while CDM project developers in the longer term could well fulfil the role of an I&T Broker, it is likely that in the short-term, they will remain dependent on the build-up of expertise within developing countries' CFIs. Here, there clearly exists a case for intervention either by DFIs or governments.

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[21] See CDM EB (2007), Annexes 28–31.

[22] See CDM Project Database, available online at http://cdm.unfccc.int/Projects/index.html.

5 Case 2: Energy Service Companies

Many small-scale EERE investments are already financially viable even without including revenues from the carbon market.[23] Still, informational barriers on the supply and demand side of the environmental finance market hamper the implementation of such measures. Again, supporting actors interested in bundling projects could be an effective instrument to facilitate small-scale EERE investments. In many countries the role of an I&T Broker on this market is assumed by energy service companies, or ESCOs (see the chapter by MacLean in this publication). These companies offer primarily end-user energy efficiency improvement services while receiving a share in the resulting savings in return. Such services generally include the design of energy efficiency projects for specific end-users, consulting on potential financial leverage (like subsidy schemes), the installation and maintenance of the necessary equipment, and monitoring and verification of a project's energy savings. Usually, the remuneration of ESCO is linked to the financial performance of the implemented measures. This fits well into the paradigm of environmental markets, as the financial performance of the measures directly depends on the environmental variable, i.e. the amount of energy saved.

An ESCO's business model also includes either the direct financing of the single project or acting as a mediator between its customers and commercial banks. While this is likely to reduce the transaction costs per project, it also shifts the responsibility to overcome the barriers on the financial market to the ESCO. Whereas ESCOs in industrialized countries can rely on a mature financial sector for project financing, ESCOs in developing countries experience considerable difficulties in securing funding for projects. Survey results presented in the World Energy Council (2008) reveal that ESCOs seeking financing face interest rates of up to 50–70%. The reasons for such high refinancing costs are again mostly of informational nature. As many observers point out, banks and other financial institutions often lack experience in lending to ESCOs. As a consequence, CFIs consider energy services as a risky business, while the financial model involved is not fully understood.[24] In most cases the perception of risks is not based on fundamental market data, as these simply do not yet exist. Hence, the fundamental informational problem which is at the heart of finance supply restrictions for EERE persists, even if ESCOs emerge on the market. As a result, ESCOs themselves tend to lend only to clients that have the highest levels of creditworthiness, and hence preferably engage in projects in the public sector. While in some newly industrializing countries—like for example in Brazil or India—ESCOs also finance industrial sector projects, the residential sector is usually not covered. [25] If ESCOs are

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[23] In such a case, EERE investments would simply not fulfil the stringent additionality criteria of the CDM.

[24] See for example Painuly et al. (2003), World Bank (2008), and WEC (2008).

[25] See WEC (2008).

to become successful I&T Brokers for smaller-scale projects, reducing financial market barriers will be of primary importance.[26] Since ESCOs in developing countries are often new start-ups and not spin-offs of larger companies, the financial sector is particularly reluctant to provide financing for such companies.

One of the most important instruments for industry start-up is, therefore, co-financing by governments or DFIs, for example through guarantees, start-up loans, loan loss reserve funds, special purpose funds, or interest credits. The most popular of these instruments is the provision of guarantees. The Brazilian government, for example, has created a guarantee facility which is partly aimed at fostering the development of ESCOs, called PROSECO. Within this facility the Brazilian National Development Bank (BNDES) shares up to 80–100% of the ESCO's credit risk, while the remaining risk is taken over by the intermediary bank.[27]

Such grants represent an instrument to foster "risk-reduced learning by doing" for commercial banks, as discussed in section 3. Such instruments provide a controlled-risk environment, within which commercial banks can train to assess the economic potential which lies within the ESCO model. As far as ESCOs in Brazil are concerned, such further training is likely to be welcome. While Brazilian ESCOs generated returns of about BRL 500 million (USD 250 million) in 2006, this represents only 2% of the expected market potential.[28]

Another very successful example for jump-starting an ESCO industry is the World Bank/GEF-supported programme in China. An initial industry development project starting in 1997 included the set-up of three ESCOs, each provided with USD 5 million of GEF grant support and USD 21 million of IBRD loan funds for scaling-up their business. The majority of projects implemented by the three pilot ESCOs were small-sized programmes in the fields of building renovation, boiler/cogeneration, kiln/furnace, and waste heat/gas recovery. The commercial success of the pilot companies was key for other companies' decision to enter the newly created market. These were also provided with technical assistance from the UK's Department for International Development. A second project with USD 26 million of GEF financing through the World Bank was started in October 2002. The objective was to further foster China's ESCO industry up to a national scale. This project includes a major loan guarantee programme and the provision of training, technical assistance, as well as policy development support for emerging ESCOs.[29]

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[26] As Painuly et al (2003) point out, there exists a plethora of other, mostly institutional barriers for the development of ESCOs, like weak legal frameworks or unfavourable public procurement practices. These are, however, beyond the actual scope of this paper concentrating on information barriers and finance.

[27] See BNDS (2008).

[28] See BfAI (2007).

[29] World Bank (2008).

The example of ESCO development in China is often quoted in the literature as a successful example for leveraging energy efficiency investments in developing countries. Indeed, the program's track record is impressive. In 2006, China's industry had grown to more than 60 ESCOs. Overall project investment volume in this year was about USD 280 million.[30] As most of the new market entrants did not receive large-scale support, the programme can be rightfully considered as a catalyser for a viable and promising new industry that can act as a I&T broker. Given the right framework conditions, the successful model might be replicable within other developing countries as well.

In general, ESCOs are likely to be in need of start-up support in most developing countries before being able to play the role of an aggregator. Instruments for such support should be, however, designed in a way that fosters learning on both sides of the financing market. Successful ESCOs would need to increase their knowledge on tapping the potential of lucrative EERE opportunities in the smaller-scale. As to the supply side of financing, programmes that provide a risk-reduced learning environment with limited duration seem to perform quite well. In the longer-term perspective the acquired expertise is likely to lead to a risk assessment that is rather based on the actual risks rather than unfounded expectations. A direct consequence of this learning process would be an improvement of financing terms for ESCOs. This, in turn, could lead to the development and scale-up of a viable energy service industry which in the longer term does not need further direct support.

6 Conclusion

The logic of market-based instruments in environmental policy is to use the profit motive for environmental improvements. This is usually achieved by privatizing an environmental good in a way that the results of these improvements are made tradable through securitization or by using already existing price mechanisms which are related – at least closely enough – to the environmental variables. The former is the case with emissions trading markets, while the latter applies to EERE. As a consequence, if the market is carefully designed, the achievement of environmental objectives for these markets can be more or less directly deduced from the actual market volume.

Within this paper we have established the case that informational considerations with respect to environmental markets need to go beyond the standard paradigm of simple measurement. It is argued that the major difference between environmental finance and standard project finance is not within the general market setup, but lies rather in the persisting information barriers that characterize the former. It can, for example, be argued that the lack of demand for financing small-

[30] Ibid.

scale projects is to a large extent due to rational or irrational ignorance with respect to the potential gains. The supply side on the other hand seems to have a significant lack of knowledge on the principal mechanisms driving these markets and on how to systematically assess the associated risks.

Evidently, the informational problems identified here can only explain a part of the underprovision of environmental project finance. However, instruments that reduce these information barriers are very likely to lead to an increase in market volume. One measure that seems to be promising for fostering small-scale investments is the bundling of such projects by an I&T Broker. In principle, such brokers are capable of yielding economies of scale and scope by pooling small- and medium-scale projects. While the development of such aggregators is clearly not a magic bullet solving all inefficiencies on the environmental markets, there is promising anecdotal evidence suggesting that this can effectively reduce the information barriers on the demand side. These examples show that project pooling can significantly increase the amount of implemented projects. We have examined two actors that could assume such a role more closely: the CDM project developer and energy service companies. As it turns out, while these actors could be quite effective in bundling projects and hence scaling-up the demand side, they still encounter significant problems for interim financing for the respective investments. In fact, the informational problem on the supply side of environmental finance seems to persist. While there is growing evidence that the risks associated with CDM and EERE projects are manageable, commercial finance institutions still seem reluctant to procure finance for these endeavours. Many observers of these markets point to the fact that this reluctance is rather based on a general lack of expertise with respect to the newly created markets, rather than a rational assessment of project risks. In light of these observations, it is important to improve CFIs' capacity to collect and process information on technical and economic potentials in all considered fields, i.e. GHG emissions mitigation measures, measures to increase energy efficiency, and projects using renewable energy resources. In this context there exists a case for government or DFI intervention. The approach of several development banks in particular – to provide risk-reduced environments for learning by doing – yielded promising results in both markets. As several of the quoted examples have shown, guarantee programs of limited duration can help to jump-start an I&T Broker industry which would be viable in the long run. In the field of the CDM, where DFIs were among the first to provide start-up equity, they provided valuable first-mover experience to the market, generating information on the actual risks for the private sector. In the field of carbon funds, private sector engagement has recently overtaken the volumes provided by DFIs. A similar effort would be needed for starting up successful programmatic CDM projects where governments could also play a significant role.

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