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Uncertainty in financing of the Clean Development Mechanism projects

The case of small-scale energy efficiency and fuel switch project in public buildings

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Abstract

The research investigates the market and policy conditions that inhibit energy efficiency in the household sector in the context of the CDM undermining its financial and environmental performance and creating uncertainties in the CDM project financing. The contribution to the practical illustration of the uncertainty impact on the project performance is undertaken by the economic and barrier analyses and building of the alternative performance scenarios for the CDM project on Energy Conservation and Greenhouse Gases Emissions Reduction, implemented in the Republic of Moldova. The present study contributes to an evaluation of the possible consequences of the market and policy conditions for the ex-post results of the project compared to its development scenario constructed ex-ante. The research confirmed the relevance of addressing the market and non-market conditions at the preparation stage of the CDM project cycle to minimize the negative consequences of their fluctuations for the project's financial and environmental results. The study proposes some solutions to reduce the uncertainties in the CDM project financing and contributes to closing the gap in the knowledge on the real performance of small-scale CDM energy efficiency and fuel switch projects in public buildings. The findings of the research can be used during the project design stage in order to take into account possible obstacles and benefits that may influence further project performance and ensure the project against underperformance. Further research on both real performance and methodological implications is needed for gaining better understanding of how the CDM energy efficiency in household sector can be further developed in the conditions of risk and uncertainty to its possible achievement of pre-designed financial and environmental goals.

Executive Summary

The purpose of the research is to contribute to understanding of what staeps could be undertaken in order to minimize the market and policy conditions that inhibit increased energy efficiency in the household sector on the ex-ante financial and environmental performance of the CDM projects, by examining a case study on energy efficiency and fuel switch in public buildings in Moldova.

During the research literature was examined to gain a better understanding of the market and policy implications for energy efficiency and CDM and identify which are relevant in the context of the considered CDM project. Empirical data was collected from the stakeholders of the CDM project on Energy Conservation and Greenhouse Gases Emissions Reduction in Moldova for the practical illustration of the uncertainty impact on the project performance through the economic and barrier analyses and building of the alternative performance scenarios for the Moldova CDM project. The contribution of this research consists of an analysis of a number of most common barriers to the financial and environmental performance of an energy efficiency and fuel switch project in public buildings, with the view of its participation in CDM; and an evaluation of the possible consequences for the ex-post results of the project compared to its development scenario constructed ex-ante. The main focus of the study was on the rebound effects associated with the suppressed energy demand and split incentive in the public buildings, market price fluctuations and transaction costs.

Th CDM project on energy efficiency and fuel switch in public buildings was taken as an illustrative example of an additional project in a sector rarely approved for participation in the CDM. This fact involves an interesting from the research point of view discussion of using the CDM as means to overcome significant barriers in implementation of the energy efficiency projects, especially in the public buildings. At the same time energy efficiency and fuel switch projects face a number of barriers and risks which are not always taken into account during the project design. Some barriers are specific to the public buildings, which justifies the choice of the illustrative case study for the present research. The findings of the research can be used during the project design stage in order to take into account possible obstacles and benefits that may influence further project performance and ensure the project against underperformance.

CDM is a very young mechanism and there is still need for more experience and knowledge about the risks and uncertainties in the CDM projects. The more projects enter the pipeline, the more lessons are learned about how to handle these risks. The research confirmed relevance of addressing market and non-market conditions at the preparation stage of CDM project cycle to minimize negative consequences of their fluctuations for the project’s financial and environmental results. The study proposes some methods to reduce the uncertainties in CDM project financing and contributes to closing the gap in the knowledge on the real performance of small-scale CDM energy efficiency and fuel switch projects in public buildings.

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1 Introduction and background

1.1 Historical background

The growing concerns of the scientific world and general public about the environment and mankind's impact on the global climate pushed for bringing these issues on the political agenda. In 1988 the Intergovernmental Panel on Climate Change (IPCC) was established to provide scientific advice to the policymakers. In 1990 the IPCC consisting of leading scientists and experts published the First Report concluding that anthropogenic emissions add to the global greenhouse effect and warm the Earth's climate (UNEP, 2004a).

In May, 1992 as a result of negotiations on an international framework convention addressing the problem of global warming, the UN Framework Convention on Climate Change (UNFCCC) was completed. It was opened for signature at the Earth Summit in Rio de Janeiro and entered into force in 1994. The UNFCCC divides the Parties into two groups: Annex I (developed industrialized countries) and non-Annex I (primarily, developing countries). The Annex I Parties take the obligations to reduce their greenhouse gas (GHG) emissions to the level of the reference year (1990) by 2000 (WWF, 2006).

At the time of adoption of UNFCCC the international negotiations started on the long-term emission caps for the Annex I countries beyond year 2000, which resulted in adoption of the Kyoto Protocol at the Conference of Parties (COP) 3 of the UNFCCC in Kyoto in December, 1997. It sets the emission reduction goal for the Parties over a period 2008-2012 as an average of 5% below their emissions in the reference year (1990). On the individual, country-by-country basis the targets are different, e.g. Japan is obliged to reduce its emissions by 6% below the level of 1990, while Iceland can increase its emission by 10% over its 1990 reference level. These targets reflect the geographical over- and underproduction of the GHG emissions, while the common goal is set to achieve "safe levels" of the GHG emissions. Kyoto Protocol also defines six GHG which should be targeted: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), leaving it up to the Parties to choose which of those to address in the national strategies (WWF, 2006).

The instruments through which the targets can be cost-effectively achieved are also introduced by Kyoto Protocol. They give flexibility to the obliged Parties in achieving their Kyoto targets. Using different instruments allows the Annex I countries to reduce emissions wherever it is least costly and then count these reductions toward their target. Kyoto Protocol establishes the following flexible instruments (UNEP, 2004b):

- Article 6 - International Emission Trading allows countries to trade their carbon emission allowances among them, transferring surplus of allowances from one country to cover excessive emissions in the other country;

- Article 12 - Clean Development Mechanism (CDM) allows the emission reduction projects located in developing countries and assisting in the achievement of sustainable development to generate certified emission reductions (CERs) which can be used by investors to comply with their emission cap;

- Article 17 - Joint Implementation allows emission reduction projects located in an industrialized country transfer achieved emission reductions to the investor country for both to comply with their emission limits stipulated under the Kyoto Protocol.

After adoption of the Kyoto Protocol, the negotiations continued to develop a set of rules and procedures to follow when aiming at compliance with the Kyoto targets. In 2001 at COP 7 the Marrakesh Accords were adopted, which set the modalities and procedures for implementation of the Kyoto Protocol. In 2005 the Kyoto Protocol came into force following its ratification by the Russian Federation in 2004 (WWF, 2006).

1.2 Energy Efficiency and Greenhouse Gas Emissions

IPCC Third Assessment Report published in 2001 contains the scientific discussion of the climate change phenomenon, its causes and effects. The report created a scientific consensus about the issue of the global warming. The causes of the phenomenon are known to be both natural and anthropogenic, the latter being the largest contribution to the emission of the greenhouse gases which are the main reason for the climate alteration (IPCC, 2001).

In 2007 the Working Group III contribution to the IPCC Fourth Assessment Report was published. It provides the development of different scenarios for the Earth's climate with a view of the existing potential for the greenhouse gas mitigation in different economic sectors. The largest potential at the lowest cost (< 100 USD/tCO_2) has been identified within the buildings sector (see Fig. 1-1). The report enumerates a range of positive aspects related to energy efficiency in buildings, both new and existing. Among them, the possible reduction of 30% of the GHG emissions in the sector with the net economic benefit. However, there are also limitations to implementation of the GHG mitigation projects in buildings at a larger scale: financing, policy choices, information and transaction costs, availability of technology, limitations of the building designs, etc. The developing world experiences these barriers at a higher magnitude than the developed countries (IPCC, 2007).

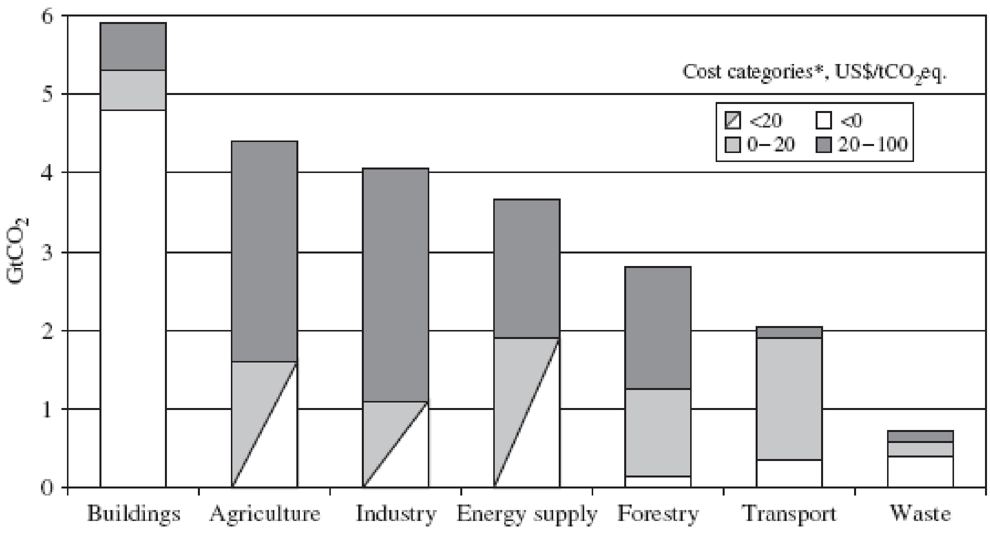

Figure 1-1 Estimated greenhouse gas reduction potential by 2030 by sector and cost categories

Source: Urge-Vorsatz and Novikova, 2008

With the view of combating the global climate change the Kyoto Protocol was agreed between the Parties to the Framework Convention on Climate Change in 1997. It addressed the issue of cost-effectiveness in mitigating the GHG emissions through adoption of “flexible mechanisms”. These mechanisms were also intended to assist developed countries in meeting their targets under the Kyoto Protocol. “Flexible mechanisms” create a new market for carbon, attracting investments into the GHG mitigation projects, thus aiming at solving the problem of project financing and at the same time developing the capital market (IETA, 2006). Different countries and regions were adopting various trading mechanisms (emission trading schemes, White Certificates, etc.) for achieving their goals of the GHG emission reduction at the least possible cost.

2 Research question and methodology

2.1 Background

CDM has been largely debated as to its achievement of the real emission reductions and a secondary goal of sustainability. As an example, the supply of carbon credits is dominated by the reduction of the industrial gases, among which HFC-23, which is 11 700 times more potent in greenhouse effect than CO_2. HFC-23 is a by-product of the refrigerant gas HFC-22. Projects that reduce HFC-23 generate enormous amounts of CERs, due to its high potency as a greenhouse gas. This fact makes such projects extremely attractive for the investors, while the cost of mitigation is very low and revenue from CERs extremely high (Wara and Victor, 2008).

Heller (2007) gives a clear explanation of why HFC-23 reduction is financially attractive in the current market conditions. Cost of abatement of HFC-23 is equal to approximately 0.1 euro/t CO_2, while the CER price for 1 kg of HFC-22 is 2.89 euro. At the same time the market price for 1 kg of HFC-22 is only 1.6 euro. The fact that revenue from CERs in the HFC-23 reduction projects is higher than the profit from production of HFC-22 created an incentive for the companies to increase their production of HFC-22. Increase in the production of the main product leads to the release of larger amounts of the by-product gases, HFC-23 in this case, creating more opportunities to capture this gas in larger quantities at low prices and gain CERs for such activity. The incentive to increase the production rather than phase-out the harmful practice is called a perverse incentive. Due to the perverse incentive created by the CDM the plants producing refrigerants transformed into plants producing CERs with HFC-22 as a by-product. The contribution of such projects to the emission reduction is clearly negative. HFC-23 reduction projects do not directly contribute to the improvement of people's living either, thus having no positive impact on the sustainable development (Wara and Victor, 2008, Heller, 2007, CAN International, 2007).

HFC-23 is just one example of the projects which do not fulfill the goal of the CDM and whose eligibility for this mechanism is questioned. There are also projects which are considered eligible while promoting subsidies to the polluting fuels, such as renewable energy projects, which would not be profitable compared to the subsidized coal unless credited from carbon trading.

Another issue is so-called “anyway” projects. Such projects would happen without the CERs revenue, but are claimed under CDM. An example can be given by the Chinese expanding electrification through a variety of sources, such as hydro, wind and natural gas. The diversion from coal to other sources is stipulated by the national policy; therefore it is logical to assume that such diversification would happen in the sector anyway. However, the individual projects in this sector claim CERs revenue marginal for their performance (Wara and Victor, 2008). More about it would be discussed in Section 3.2 on additionality.

The initial design, purpose and justification of the project matter a lot in order to be considered eligible for the CDM. The project developers, investors and governments are interested in claiming their projects need CERs to be implemented. In some sectors this may create perverse incentive, like in the refrigerant gases industry; in others it might lead to manipulation with the additionality demonstration (Heller, 2007).

On the other hand, there is a multitude of the small-scale projects, which may generate real emission reductions and improve the living standards of the people, but they are rarely considered eligible. Among these are energy efficiency projects, which usually generate savings on their own (Reynolds, 2008).

The initial design of the project is important for the real performance. However, even if a project has been considered compliant with all the CDM requirements, it might become a project that will not achieve its goal in the end and will not contribute to the sustainable development and the emission reductions. During its implementation the project faces a lot of barriers. Its participation in the CDM may be justified for overcoming certain barriers, but different constraints have a tendency to change over time and have an impact on the project results, which were not assumed in the ex-ante evaluation of the project.

The biggest uncertainty with CDM lies in its assumptive nature. CERs are issued based on a simple calculation of the difference between what might have been emitted if no project taken place and what really was emitted after the project had been implemented. In the project design, however, the project emissions are also estimated, raising uncertainty. Thus, the actual project performance evaluated ex-post may be different from what was expected in ex-ante evaluation of the project results. The discrepancy between the estimated and the actual performance may affect the project's contribution to sustainability and the overall reasonability of the project implementation.

2.2 Research purpose and questions

The purpose of my research is to contribute to understanding of what could be done in order to minimize the market and policy conditions that inhibit increased energy efficiency in the household sector on the ex-ante financial and environmental performance of the CDM project, by examining a case study on energy efficiency and fuel switch in public buildings in Moldova.

My research questions I used for structuring my study:

- How is the performance of the CDM project estimated ex-ante?
- What market and policy conditions influence the financial and environmental performance of the CDM projects on energy efficiency in households?
- What impact do these market and policy conditions have on the financial and environmental performance of the CDM projects on energy efficiency in households?

and finally,

- What measures can be implemented to address these conditions?

In order to know what to expect and what issues to address when designing a CDM project, a real and operating CDM project on energy efficiency and fuel switch in public buildings was taken as an illustrative case study. The choice of the case study is justified by the following project characteristics:

- It is a project, which satisfies the additionality requirements in the sector (energy efficiency in households) rarely applied and approved for participation in the CDM;

- The project involves an interesting from the research point of view discussion on using CDM as means to overcome significant barriers in implementation of the energy efficiency projects, while such projects usually face a number of barriers and risks which are not always taken into account during the project design.

- The project addresses the energy efficiency on the supply side at the individual level of a household and fuel switch measures. The barriers addressed in the present research are common for energy efficiency and fuel switch in households (residential and public) and the findings of the study can be partly replicated or extrapolated on the other types of energy efficiency projects in households;

- Some of the barriers for the project are specific to public buildings, which are also a vulnerable sector in terms of financial capability to implement projects that go beyond business-as-usual;

- The uniqueness of the project. CDM pipeline includes only 9 projects in energy efficiency in buildings, among which only 5 are registered. 2 projects comprise a bundle of a large number of buildings. Moreover, only one project is focused on fuel switch besides energy efficiency and on public buildings as a target sector (Fenhann, 2008);

- The project has not been studied before and due to its recent commissioning in 2005 the project's ex-post performance has not been evaluated yet.

2.3 Research methodology

The research is based on the analysis of the on-going Clean Development Mechanism project on Energy Conservation and Greenhouse Gases Emissions Reduction implemented in the the Republic of Moldova.

The research has been performed in three steps:

- Literature review with the examination of the theoretical and practical findings in the relevant studies. The review consisted of the examination of the recent studies on policy, economic and technical aspects of energy efficiency in buildings, greenhouse gas emissions mitigation, and Clean Development Mechanism. The literature review was done for the purpose of understanding of up-to-date scientific knowledge about the subject of the research and selecting a range of theoretical frameworks and instruments to base the analytical part of the research on: economic theory, theory of transaction costs, barrier analysis, and economic analysis.

- Document review with examination of the case documentation, both country- and project-specific, conduction of a range of interviews with the relevant stakeholders, site visits. The document review was performed with the view of collecting information and empirical data about the project's ex-ante and ex-post financial, environmental and social performance.

- Analysis of the case-specific empirical data with application of the theories and methods determined during the literature review: building of the alternative performance scenarios, cost-revenue and sensitivity analyses.

The main purpose of this study is to identify a range of the market and policy obstacles to the energy efficiency projects in public buildings and assess how they may change the project performance indicators. Through the literature review the following barriers have been identified: suppressed demand and rebound effects, budgetary constraints and the associated split incentive, transaction costs and market risks. Market risks include the volatility of the fuel prices and the CER prices. The suppressed demand and the associated rebound effects inhibit environmental additionality; budgetary constraints are a general barrier to the project implementation, but under certain circumstances, defined in the analytical part, can become an obstacle for the social and environmental performance of the project; market risks influence the economic profitability of the project.

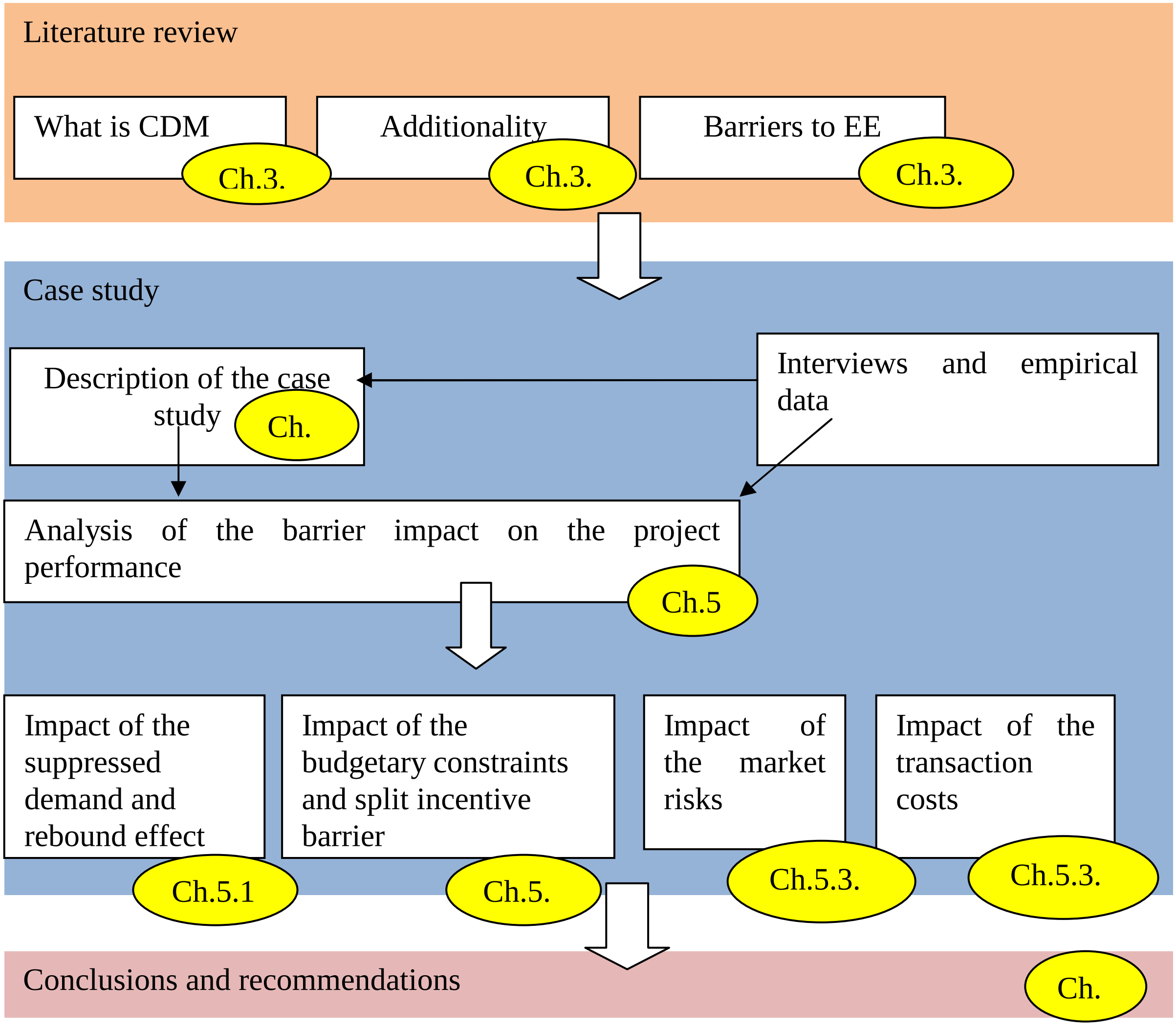

Figure 2-1 Research methodology

Source: constructed based on Sutter, 2001

The empirical data and information about the actual performance of the project has been collected from the Energy II Project and Carbon Finance Unit (CFU) Moldova, through the personal interviews with Petr Comarov, the energy expert of Moldova Energy II Project Implementation Unit (MEPIU), Dumitru Braga, the technical expert of CFU Moldova, Stela Drucioc, the director of the CFU Moldova and Jorge Gastelumendi, the Community Development Carbon Fund (CDCF) of the World Bank (WB). The interviews were conducted using open-ended questions. Interviewees were selected due to their direct participation in the CDM project under investigation, ability to provide primary data and objective and reliable information regarding the project preparation and its performance during the later stages of the CDM project cycle.

The primary data include:

- Project activity (PA) information: type of the building, location, current heating capacity, installed heating capacity foreseen under the project, type of the current fuel, type of the current heat generator (Annex B);
- Measured data on the fuel use for each PA in 2004 (reference year);
- Projected emissions and emission reductions for the crediting period;
- Initial assumptions under the project's design document for construction of the baseline and project scenarios (Annex C);
- Actual data on the fuel consumption and emission reductions generated by the project activities for 2006-2007.

The analytical part of the research includes the demonstration of the project's suppressed demand and building of the energy consumption scenarios with the incorporated annual energy consumption increase due to the rebound effect; building of a scenario reflecting the hypothetical changes in the budget and the associated rebound effect; the analysis of the project's financial indicators and the sensitivity analysis against the changes in the fuel price and the CER price; building of the scenario reflecting the incorporation of the transaction costs into the total cost of the project; the analysis of the project's actual environmental performance. All associated calculations of the variables used for construction of the models, scenarios, and performance of the analyses are given in Annex D.

Based on the findings from the analysis of the case study, the conclusions and recommendation are made on use of the methods for the uncertainty reduction and performance optimization of the CDM energy efficiency projects in households at the initial stages of the project development as well as the suggestions for the further research.

2.4 Scope and limitations

The research focuses on the application of the CDM to the greenhouse gas mitigation through the energy efficiency and fuel switch measures in the household sector, specifically public buildings.

The geographical scope of the research is Moldova, with possible application of the study results to the Former Soviet Union countries with a similar situation in the heating sector.

The subject of the study is the uncertainty in the CDM financing through evaluation of the market and policy conditions and their impact on the CDM project performance from the triple bottom line: economic, environmental and social. The analysis of the impacts includes both quantitative and qualitative evaluation.

While there is a multitude of various market, behavioural, policy, technology, etc. conditions which inhibit the implementation or performance of the energy efficiency projects, also within the CDM, the analysis was limited to a certain number of conditions, which were selected according to their particularity to the energy efficiency, CDM and public buildings simultaneously, and relevancy for the project under study.

The research was constrained by the lack of the previous studies, and therefore available data on the similar projects in the region; lack of availability of the empirical data for the selected categories of the indicators.

2.5 My contribution

My contribution consists of an analysis of a number of the most common barriers to the financial and environmental performance of an energy efficiency and fuel switch project in public buildings, with the view of its participation in the CDM; and an evaluation of the possible consequences for the ex-post results of the project compared to its development scenario constructed ex-ante. The practical illustration of the barriers' quantitative impact on the CDM project performance is given by the analysis of the on-going energy efficiency and fuel switch project in the public buildings in Moldova: a type of project, which has not been widely addressed in the literature, but is demanded for its sustainability benefits for the developing world. The present research also provides a qualitative and quantitative assessment of the actual results of the CDM project, the ex-post performance of which has not been previously evaluated. Based on the findings from the actual project performance and modeled scenarios, the research contributes to the understanding of which uncertainties in the CDM financing need to be addressed, what impact could be expected and how it could be mitigated during the designing stage of the CDM project performance.

3 Literature review

3.1 What is CDM

The Clean Development Mechanism (CDM) is a flexible instrument which is designed to assist developing countries in their achievement of the sustainable development by attracting foreign investments in the GHG emission reduction projects through trading of the carbon credits. CDM has been established under the Kyoto Protocol, the main requirement of which is for the Parties to limit or reduce the greenhouse gas emissions (UNEP, 2004b).

The scientific world agrees that it does not matter where on the Earth the reductions take place; therefore it is economically sound to cut the emissions where it costs least. The flexible mechanisms established under the Kyoto Protocol were designed as market-based to achieve this goal. While a number of countries accepted a cap on their emissions under the Kyoto protocol, there is a range of countries which are still on their developing path and their emissions will be increasing while their economy grows. The flexible mechanisms provide for the technology transfer from the developed world to the developing countries, helping them achieve the sustainable development and allowing the investing countries comply with their obligations under the requirements of the Kyoto Protocol (IETA, 2006).

The GHG emission reduction projects implemented under the CDM allow generation of the certified emission reductions (CERs) which can be traded in the carbon market and used by the investing country to meet its emission reduction target under the Kyoto Protocol. Possibility to trade CERs makes the project more financially attractive, creating an additional source of revenue. At the same time, the Kyoto Protocol does not exclude unilateral projects, where the developing countries are investors themselves (UNEP, 2004a).

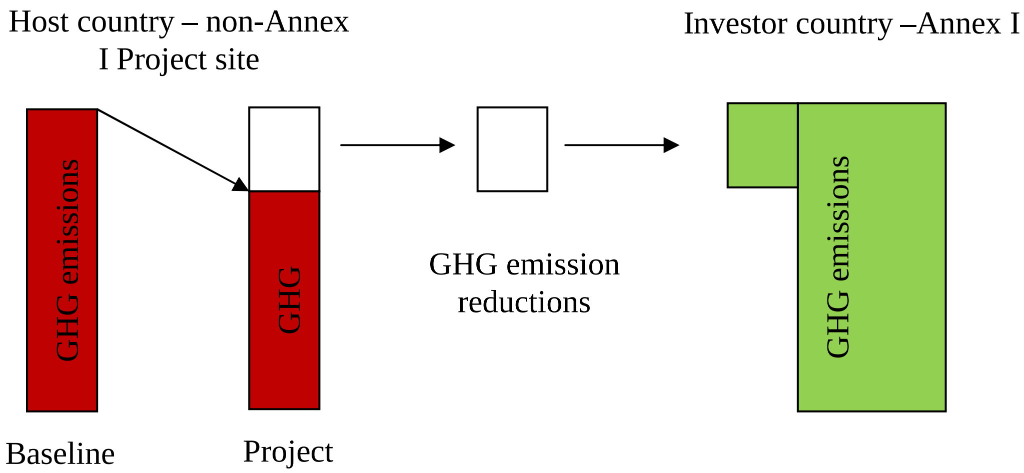

Figure 3-1 How CDM works

Source: WWF, 2006

3.1.1 CDM organizational structure

CDM is an instrument which is administered by an organizational structure. It has a supervisory body, technical panels and groups, independent consulting/auditing bodies, national designated bodies, and project participants.

The CDM Executive Board (EB) supervises CDM under the guidance of the Conference of Parties, which is a meeting of the Parties to the Kyoto Protocol. The CDM EB consists of 10 members: 1 from each of the 5 official UN regions, 2 from Annex I Parties, 2 from non-Annex I Parties, and 1 from the island developing states. The EB is responsible for the recommendations on the modalities and procedures; development of new methodologies, including baseline calculation and monitoring; accreditation of the Designated Operational Entities; ensuring public access to the project design documents and discussion of the draft methodologies; creation and maintenance of the registry; official registration of the approved projects; issuance of the CERs. The EB can organize Panels and Working groups (WGs) of experts to base its activities on the accumulated expertise (UNEP, 2004a, WWF, 2006).

The CDM Panels and Working groups include (WWF, 2006, IETA, 2006):

- Methodologies Panel: assesses proposals for the new methodologies;
- Afforestation and Reforestation WG: develops modalities and procedures for the afforestation and reforestation projects;
- Small-scale WG: develops modalities and procedures for the small-scale projects;
- Accreditation Panel: manages the accreditation of the DOEs.

The Designated Operational Entities (DOE) are independent third-party organizations, which carry out the validation of the project design and verification and certification of the project performance during the use phase. DOE also sends a request for the project registration after its validation and issuance of the CERs after the verification and certification of the emission reductions. Validation and verification should be performed by different DOEs, however, sometimes the EB can accredit one DOE to fulfill both functions within one project (IETA, 2006, UNEP, 2004).

The Designated National Authorities (DNA) are bodies set up at the national level by the CDM participants, which can be either the participating countries or private or governmental organizations, designated by the participating countries. The role of the DNA is to submit the project approval letter, confirming that the project fulfils the basic CDM requirements, and namely (WWF, 2006):

- The party, which DNA represents, ratified the Kyoto Protocol;
- Participation in the project is voluntary;
- Project contributes to the sustainable development of the hosting Party.

3.1.2 CDM projects

CDM as the rest of the flexible mechanisms of the Kyoto Protocol is designed to promote international investments into environmentally sound technologies. However, focusing on the developing countries this mechanism makes the sustainable development an eligibility criterion when applying for the CDM. By promoting projects which improve all three bottom-line aspects of the Sustainable Development: economic, social and environmental, CDM aims at poverty alleviation, improvement of energy supply, less dependence on imported fossil fuels, improved air quality, rural development, etc. (UNEP, 2004b).

The scope of the CDM covers a range of economic sectors, reflected in Annex A to the Kyoto Protocol (IETA, 2006; UNFCCC, 2008a):

- Energy industry (including renewable energy);
- Energy distribution;
- Energy demand;
- Manufacturing industry;
- Chemical industry;
- Construction;
- Transport;
- Mining and mineral production;
- Metal production;
- Agriculture;
- Fugitive emissions from fuels (fuel switching);
- Fugitive emissions from the production and consumption of halocarbons and sulfur hexafluoride;
- Used solvent;
- Waste management;
- Carbon sinks (afforestation and reforestation).

Specific baseline and monitoring methodologies were developed for each of the scopes. The CDM projects are also divided into large and small scale. The types of the small-scale projects focus on the supply and/or demand-side energy efficiency, renewable energy and fuel switching. The limits defining the small-scale are set as following (UNEP, 2004a):

- Maximum 15 MW output capacity for the renewable energy projects;
- Maximum reduction of the energy consumption by 15 GWh/year for the demand- or supply-side energy efficiency projects;

- Maximum direct emission of 15 kilotons of CO2 e annually for other projects which reduce emissions.

Small-scale projects are benefitting from the simplified modalities and procedures for the demonstration of additionality, baseline calculation and monitoring. The rules for the small scale projects are less complicated than for the large scale. In developing countries with a lower capacity for the large initial investment small projects may serve as pilots to create a pattern for the sustainable development. Environmental integrity, which is considered crucial for the CDM projects, may be lost in some small scale projects; therefore rules for such projects are less strict on the environmental integrity, while other effects, such as social and technological, are more important. Simplified rules reduce transaction costs, thus lessen the cost burden on the small-scale projects, which do not generate large revenues, making them more competitive (IETA, 2006).

3.1.3 CDM project cycle

The first step in a CDM procedure is the project identification. The project description constitutes a project design document, which when approved and verified is the basic document for the project registration.

The project should be real, measurable and additional (UNEP, 2004a). The additionality criterion is central to the CDM projects and more of explaining the additionality will be in the Section 3.2. To demonstrate additionality the project has to establish a measurable baseline or an assumed scenario of what would be happening if there was no project. Baseline development is also very important for the calculation of the emission reductions and therefore of the future potential revenues from the CERs. Thus, it is very important to estimate the baseline accurately (Gustavsson et al., 2000).

The potential project emission reductions also have to be estimated in the project, as well as a plan for their monitoring and calculation mode. Both the baseline scenario and the monitoring plan are developed according to the methodologies applicable for the specific project. For small-scale projects there exist simplified methodologies for the various categories of projects.

After the project design document (PDD) is developed it has to be evaluated and approved by the Designated National CDM Authority set up by each participating country. The Authorities issue the approval documents, stating voluntary participation of their countries in the CDM and the contribution of the project to the sustainable development.

After the approval the Designated Operational Entity reviews the PDD and decides upon its validation. At the end the validation report is issued and the PDD is sent to the Executive Board for registration. When the project is officially registered it can be financed and implemented.

The course of the project performance is regularly monitored by the project managers according to the monitoring plan. The plan usually includes a list of the necessary records to be taken during the monitoring periods. The emission reductions cannot be converted in the monetary value unless verified by a third-party. Monitoring reports and field sampling is done by the DOE to check the accuracy of the recorded emission reductions and application of the methodologies in the PDD. The outcome of this stage is a verification report produced by the DOE, which also certifies the verified emission reductions as CERs. Certification report also contains the request to the EB for issuance of the CERs. If no further review of the emission reductions is requested within 15 days, the EB instructs the Registry to issue CERs for the given project (UNEP, 2004b, IETA, 2006).

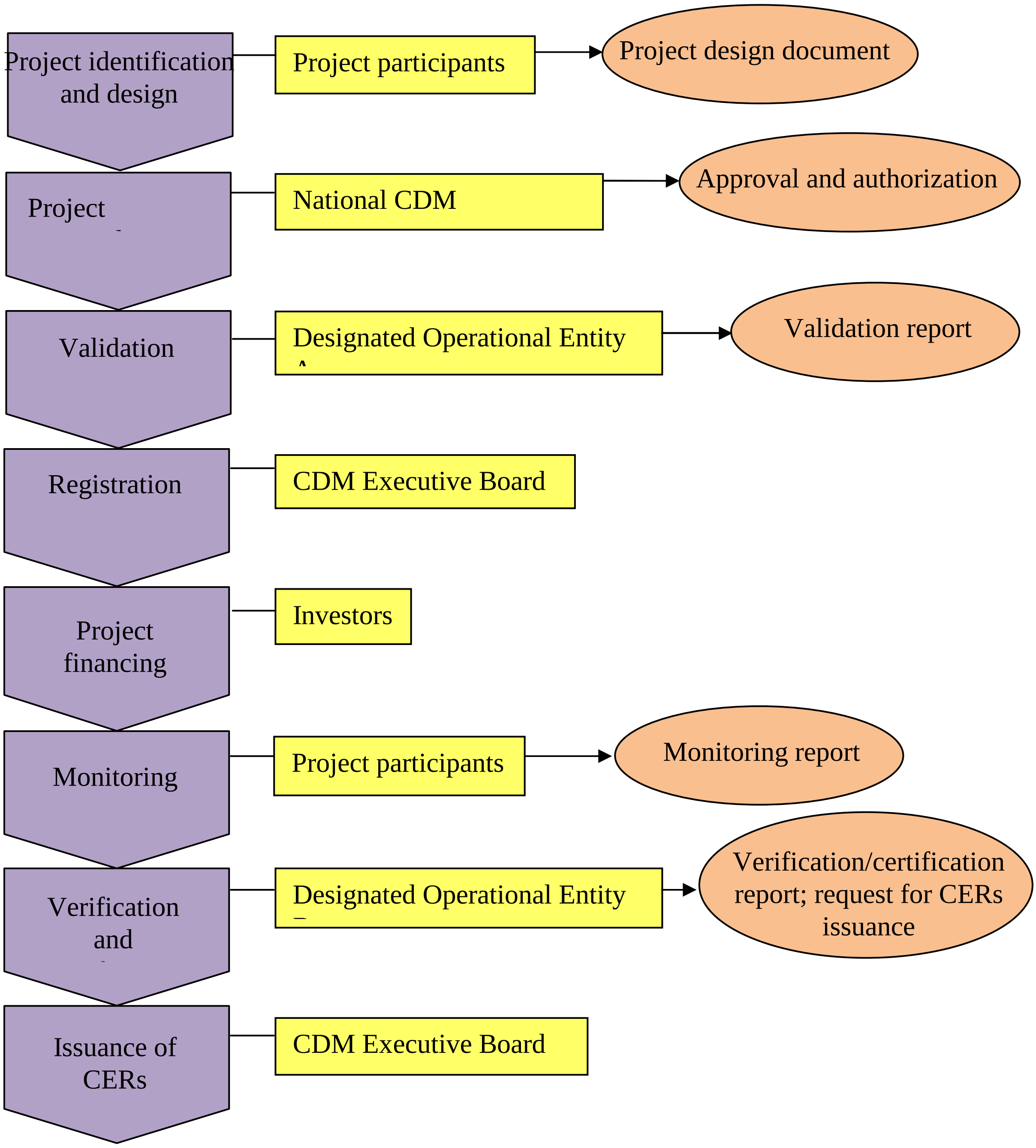

Figure 3-2 CDM project cycle, responsible bodies and document flow

Source: constructed based on UNEP, 2004a

3.1.4 CDM and Energy Efficiency

All projects requested for registration, at validation or registered form the CDM pipeline. The pipeline has been growing since 2005, when the Kyoto Protocol came into force. According to the UNFCCC statistical data, the total pipeline includes more than 3000 projects, of which 1149 are registered. The growth of the registered projects is illustrated in the Figure 3-3. According to the UNFCCC report on the investment and financial flows in the carbon markets, the investments into the CDM grew from 7 billion USD in 2005 to 25 billion USD in 2006 (UNFCCC, 2008a; Fenhann, 2008).

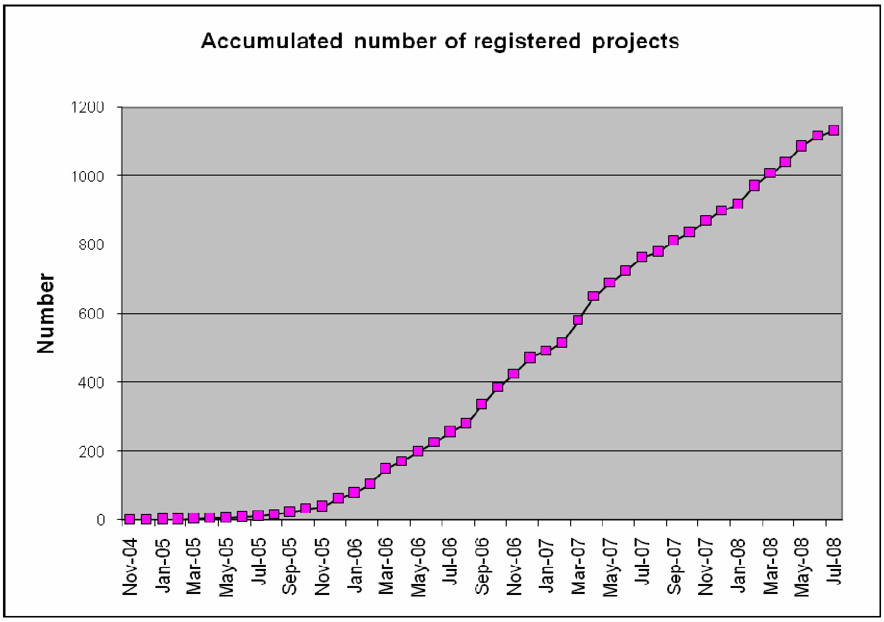

Figure 3-3 Accumulated number of registered CDM projects

Source: Fenhann, 2008

As of August 2008, the majority of the projects are in energy industries, renewables and non-renewables, primarily in China, India and Brazil. Small scale projects comprise 46.4% (533 projects) of the total registered projects. Among which the energy demand projects are only 18 (1.23%). Comparing to the total pipeline only 5% are the demand-side energy efficiency projects. The demand-side projects include energy efficiency in industry, commercial buildings and households. The largest share of the projects belong to industry. The share of the projects on EE in households is less than 1%. There are in total 9 EE in households projects in the pipeline, among which 5 are registered: 4 in households and 1 in a commercial building (hotel) (UNFCCC, 2008a; Umamaheswaran and Michaelowa, 2006).

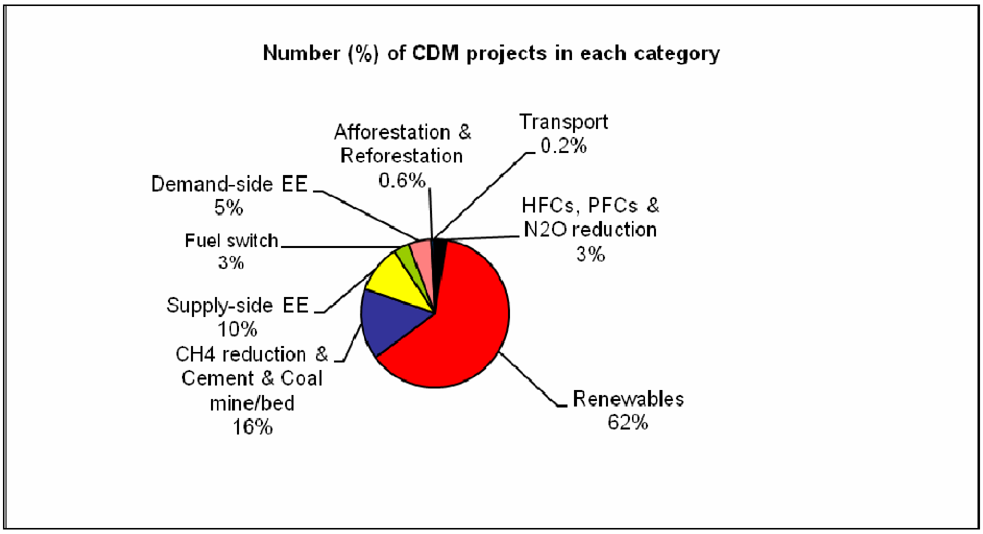

Figure 3-4 CDM projects by category (%)

Source: Fenhann, 2008

The total amount of the CERs expected from the CDM by 2012 is equal to 174 millions. The largest share of the issued CERs is in HFCs, PFCs and N_2O reductions (73%); for the demand-side energy efficiency projects there are no CERs issued yet. EE projects in households are not generating CERs yet and the amount expected by 2012 is very low. Comparing to the EE in industry the households energy efficiency would generate 24 times less CERs by 2012 (1.4 million against 3.3 million) (Fenhann, 2008). Such fact shows that although energy efficiency is named by IPCC (2007) a promising sector for the GHG mitigation at the lowest cost, it has not realized its potential. While the industry is performing much better in the CDM, the household sector is facing barriers to energy efficiency. The ability to overcome barriers is tightly connected with the purpose of the CDM and incorporated in its modalities and procedures.

Before relating the CDM and barriers to energy efficiency in households, first I would like to discuss one of the main CDM requirements, which can possibly be a reason for the low share of the energy efficiency projects in the pipeline. The DOEs reported that over the 2003-2006 they rejected 369 (18.5%) projects at validation. The EB rejected 70 out of 1381 projects (Fenhann, 2008). Many of the projects are not registered, because they cannot show compliance with the CDM requirements. One of these requirements, the most controversial and widely discussed, is demonstration of additionality. By March 2008 17% of the projects were rejected because they could not show the investment or financial additionality (WB, 2008)

3.2 Additionality

Additionality is a central concept in the CDM. On the basis of the additionality criteria the projects are selected to use the mechanism. The project is considered additional if it would not have happened anyway, without being registered as the CDM. This concept has been introduced to preserve the environmental integrity of the CDM (Umamaheswaran and Michaelowa, 2006). A simple illustration shows what is meant by the environmental integrity. If I am contributing to an increase in CO_2 emissions by driving a car, for instance, I can either stop doing this or buy carbon offsets to finance the emission reductions somewhere else. If these offsets had been generated from an emission reduction project which would not happen without my financing, I truly contributed to the emission reduction in some part of the Earth. If the project did not really need my money to be implemented, I just subsidized some activity that would have happened anyway (Kollmuss et al., 2008). In order not to allow such "business-as-usual" projects as the CDM, the additionality principle has been introduced for screening of the projects.

The project maybe not additional in two cases: if it would happen in the absence of the CDM or if it did not generate lower emissions compared to the emission level that would happen in the absence of the project. What would happen in the absence of the project is called a hypothetical baseline scenario. Thus, first step in demonstrating additionality is to prove that some other scenario other than the project is the most probable baseline. For that purpose (and other, like the emission reduction calculation), this probable business-as-usual scenario needs to be identified (Kollmuss et al., 2008; UNIDO, 2003). Development of the baseline scenario and additionality cannot exist without each other. As any project has economic, environmental and social characteristics, the divergence between these characteristics in the most probable and the considered project scenario should be the estimation of the project's additionality.

Marrakesh Accords, paragraph 43, define additionality as follows: "a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity" (Yap, 2007). That is if there is any other possible scenario that is generating larger emission reductions and is more likely to happen, the project is not additional. The statement above shows that it is not enough to show that the given project is different from the supposed baseline. It has to be environmentally more attractive than the baseline in terms of emission reductions.

There is a large debate around the additionality definition, importance and necessity of having such a concept in the Kyoto Protocol. Scientists, businesses and non-governmental organizations (NGOs) have their own opinions on the additionality. In their study of the additionality and Sustainable Development of energy efficiency CDM projects, Umamaheswaran and Michaelowa (2006) give an overview of opinions of different societies. Scientists typically believe that "non-additional projects might grant greenhouse gas credits to any ordinary foreign direct investment that uses more efficient technology than the one existing in the host country and would lead to the generation of low value CERs" (Umamaheswaran and Michaelowa, 2006, p. 12) . Businesses disagree, claiming that "in its present form, the additionality tool exposes every project to a highly subjective assessment of its CDM eligibility and allows for second-guessing by the EB" (Umamaheswaran and Michaelowa, 2006, p. 12). NGOs state that without additionality CDM will lose its environmental integrity: "Without additionality, the CDM results in increased global emissions and thus the additionality criteria should be strict and the enforcement must be effective" (Umamaheswaran and Michaelowa, 2006, p. 12). Most studies show that additionality is important for maintaining the Kyoto Protocol's environmental integrity; however, they also argue that too strict additionality rules would reduce the number of total CDM projects and the supply of CERs, therefore avoiding a decrease in CERs price. This may create a perverse incentive for the countries (Sugiyama and Michaelowa, 2001).

The process of demonstrating additionality includes a choice among a number of possible scenarios. The choice is made based on several factors: economic, technology, regulatory, common practice (UNFCCC, 2007a).

UNIDO (2003) conducted a study "Guidelines to support decision-making on baseline-setting and additionality assessment for industrial projects", in which it identifies various types of additionality:

- Environmental additionality – the project generates lower emissions than the baseline alternative;
- Regulatory additionality - the project complies at least with all existing regulations;
- Technological additionality - project foresees transfer of new and/or innovative technology, previously not used locally;
- Economic additionality - CDM makes a financially unattractive project competitive;
- Barrier removal additionality - participation in CDM removes barriers to project activity (investment, technology, information, capacity building, etc.);

The debate among the negotiating parties resulted in abolishment of the categorization of additionality. At the moment the economic additionality concept, largely discussed, is not supported by the majority of negotiating parties (Greiner and Michaelowa, 2003).

A schematic representation of the additionality check process is shown below:

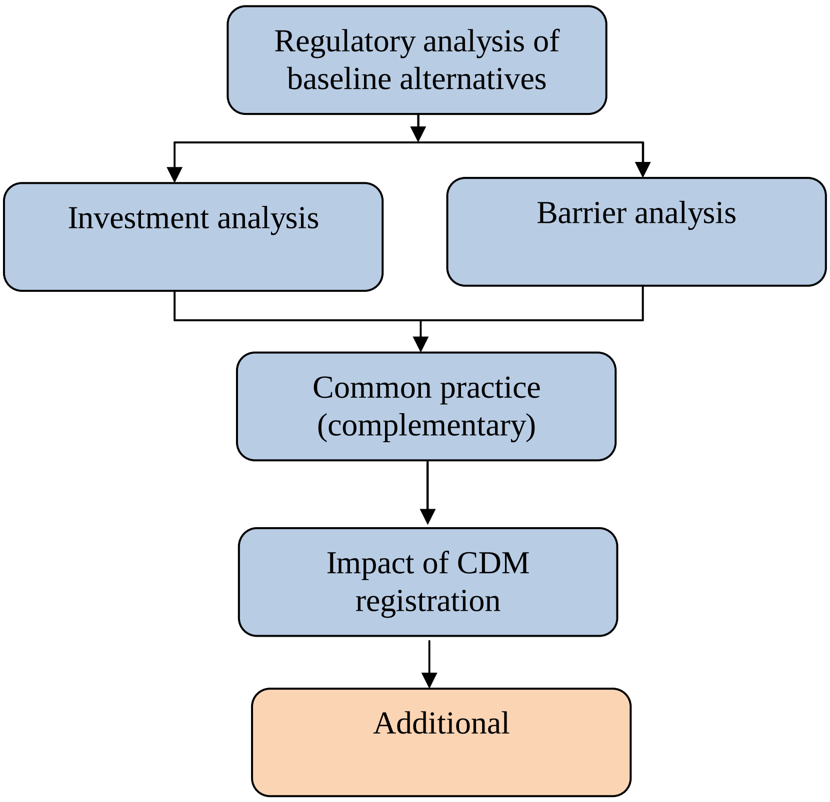

Figure 3-5 Process of demonstration of additionality

Source: Wakabayashi and Sugiyama, nd

For small-scale projects the simplified procedure of additionality demonstration requires only barrier check. Michaelowa (2005) argues that any project faces barriers; thus it is important to determine a certain level of barrier impact or threshold for additionality to avoid manipulation. Otherwise, the projects, which could overcome barriers without CDM, may be considered additional.

3.2.1 Economic additionality

Economic additionality (or investment additionality, as called in some studies (Greiner and Michaelowa, 2003) and UNFCCC documents (Shrestha and Timilsina, 2002) raised the largest debate among the negotiating groups at COP 6 (Ertel and Egelston, 2000). Financial additionality, which requires the CDM project not to lead to diversion of the official development assistance (ODA) is not discussed in this study (Dutschke and Michaelowa, 2006).

At the core of the economic additionality there is a simple assumption that projects, which are financially profitable without revenue from the emission reductions, would be implemented anyway (Reynolds, 2008). Although this statement looks logical, it provoked a lot of opposition from business and even academia. Business is concerned with the fact, that some very profitable projects are not implemented anyway due to severe barriers. Application of a pure economic additionality criterion to such projects would prevent their implementation. Academia raises the argument for the initial design of CDM as a cost-effective tool in achieving emission reductions. The most economically attractive projects would be excluded from CDM if screened through economic additionality. However, these projects are also most cost-effective and that is the purpose of CDM as a flexible tool (Greiner and Michaelowa, 2003). This paradox, described by Grubb et al. (1998), raised a strong objection to economic additionality.

However, while CDM can become a catalyst to the projects which have low profitability or are slightly unprofitable, it is not reasonable to consider any profitable emission reducing project for CDM. If no economic additionality is applied, almost any construction plan for a coal-fired power plant in a developing country would be capable of gaining CERs because it is more efficient than the existing power generating unit (Trexler and Kossloff, 1998).

Another problem related to the economic additionality is consideration of macro- and sector-scale. An example of the policy impact can be clearly seen in a case of the existing subsidies on fossil fuels in a considered developing country. If a proposed renewable energy project is economically unattractive/unprofitable compared to a subsidized coal plant and therefore additional, in the absence of a subsidy it might become more attractive and thus, non-additional. This may create an incentive for the state to continue enforcement of fossil fuel subsidies and overall inefficient policy. Greiner and Michaelowa (2003) propose in this case to separate micro- and macro-additionality and look into macro-additionality as a tool for phasing out perverse incentives.

Sectoral changes are also an issue when discussing economic additionality. Shrestha and Timilsina (2002) argue that sectoral impacts have to be taken into account when addressing the economic additionality, not only individual project. In case the planned cleaner coal technology is not the least-cost option (over traditional coal-fired technology) it may be considered additional and registered under CDM. However, it can be more cost-efficient at higher generation rates, and therefore might replace the capacities of existing renewable, hydro- or gas-based power plants. This may result in higher emissions than the baseline for the whole power sector.

As it was mentioned before, the biggest concern of the business about the economic additionality was the barriers that profitable projects might face in the developing countries. Usually such economies are characterized by a number of investment, financial, technical, technological, political, and other barriers which may prohibit the implementation of an investment project, even if it is financially attractive (Reynolds, 2008; Michaelowa and Fages, 1999). Therefore, the additionality test requires an explanation of the barriers preventing implementation of a project, and demonstration of how CDM helps overcome these barriers (UNFCCC, 2007a).

Shrestha and Timilsina (2002) propose to look at the projects seeking registration under the CDM as two groups: “economically regret” and “economically no regret”. First group is financially unattractive, while the second is profitable. The first group is economically additional, unless the CDM does not help overcome the cost barrier and makes the project not viable even with additional revenue from carbon trading. The second group, however, should also be divided into two groups. Shrestha and Timilsina (2002) base this division of economically viable projects on the criterion of funding availability. Generally speaking, availability of funds is a barrier criterion. If funds are available, then the project does not face a financial barrier and can be implemented without additional revenue from the CERs. If, on the contrary, there is a lack of access to the funds, the use of the CDM may be crucial, making such a project additional. However, if no such individual approach is undertaken and only a pure economic additionality criterion is applied, an economically attractive, but constrained by the barriers projects would be deemed non-additional and excluded from the CDM. It should be noted, that besides the funding barrier there are a number of other barriers to investment projects, which may inhibit their implementation. This is what usually happens to the demand-side energy efficiency projects. These projects generate savings, thus having a positive and sometimes high return on investments. However, energy efficiency projects are not widely implemented in developing countries. This happens due to a number of general barriers to energy efficiency, like a split incentive, information barriers and transaction costs (Koeppel and Urge-Vorsatz, 2007).

The savings arising from the energy efficiency improvements are usually also affected by the rebound effect, and in low-income households by the suppressed demand, which leads to the increase in the energy consumption, and therefore emissions. As a result the savings are not as big as expected and the project may not be as economically viable as planned when not taking these impacts into consideration. For some demand-side energy efficiency projects the energy savings have been reduced by as much as 75% due to the rebound effect (Shrestha and Timilsina, 2002).

The availability of funding and rebound effects are not the only barriers a profitable project may face. Some studies, such as Michaelowa and Fages (1999) show that there are a number of other barriers, such as information barriers, juridical, regulatory and political obstacles and lack of skilled human force. Shrestha and Timilsina (2002) argue that these barriers would remain anyway whether the project is considered for the CDM or not. However, I would like to point out that governmental interest in the CDM itself and/or revenues from the CERs, if significant enough, may help overcome some of the above mentioned barriers. On the other hand, there is a risk to create a perverse incentive for the hosting country to keep the regulatory or political barriers to clean technology transfer, if they are a prerequisite for the CDM and associated foreign investments.

In order to evaluate the economic additionality, the following criteria has been proposed by a range of studies, summarized by Greiner and Michaelowa (2003). The CDM project is economically additional if:

- Real barriers to the CDM activity can be demonstrated, which are absent for the reference case, and activities to overcome them;
- Total or investment costs of the CDM project activity exceed those of the reference case;
- The net present value (NPV) of the reference case is bigger than NPV of the CDM project activity;
- The internal rate of return (IRR) of the reference case is bigger than IRR of the CDM project activity;
- The difference between NPV or IRR with the CERs and without the CERs is significant compared to NPV or IRR without the CERs

The study shows that each of the criteria has drawbacks and may not be applicable for all projects. For example, the last criterion if applied to a highly profitable project might reflect large additional revenue coming from CERs, thus claiming the project additional. However, being very attractive financially, such project would hardly be defined as additional. This criterion may work for slightly unprofitable projects, for which the additional revenue from carbon trading may bring the NPV to a positive level. However, thinking about possible manipulations, carbon revenue is highly dependent on the CERs prices, thus being not a very reliable criterion.

Greiner and Michaelowa (2003) state that financial indicators, such as NPV and IRR, are more reliable and should always be used when performing an economic additionality test. For socially important profitable projects facing barriers, the first criterion may work well, if the activities to overcome barriers are described and the role of the CDM is shown. This concerns the small-scale projects which benefit from a preferential regime of the simplified additionality demonstration through a barrier test.

3.3 Barriers to energy efficiency in households

According to the procedure for the small-scale energy efficiency projects, their additionality has to be tested against the barriers. In 2007 the United Nations Environmental Program (UNEP) together with the Central European University (CEU) developed a guide on assessment of the policy instruments for reducing greenhouse gas emissions from buildings. The study lists general barriers to energy efficiency in buildings (Koeppel and Urge-Vorsatz, 2007):

- High initial cost

Implementation of retrofit measures involves a certain investment, sometimes quite substantial. Energy consumers, especially low-income households or public institutions in developing countries, cannot afford a high upfront cost of the efficiency improvements. A high initial investment is believed to be the most important financial barrier to energy efficiency.

- Hidden costs and benefits

The profitability of energy efficiency measures is based on a comparison between the main initial investment and returns on it in the form of energy savings. However, besides a high investment cost, there are hidden costs to the consumer during the use phase, which are not calculated in the expenses: high transaction costs due to fragmentation of the end-users and market risks associated with the new technology (required additional investments into infrastructure or price fluctuations for fuel, etc.). Besides costs there are also hidden benefits to the end-users, which are again not accounted in the cash flow: improved indoor climate, better comfort, improved air quality and health.

- Market failures

Basically, the only ones who are interested in energy savings are the end-users who pay the energy bills. In the market, the end-users are not always the owners of the building, responsible for the investments into the upgrade of the building and its systems. Thus, the benefits are received not by those who invest. This difference is called “a split incentive” in the literature. The energy producers are not interested in reducing the consumption either, because this increases their production costs. In the case of the public sector, the institutions are limited in their expenditures by the budget.

- Behavioral constraints

Individual households as well as companies tend to neglect small opportunities to save energy. Usually it is difficult to change habits and the lifestyle. Behavior patterns can be to some extent explained by the lack of awareness and access to information, especially in the developing countries. On the other hand, the changes in the consumption pattern after the level of energy service and cost changes influences the expected savings. Rebound effects reduce the potential savings for some energy efficiency measures by 5-75% (Srestha and Timilsina, 2002). In the developing countries, especially among low-income strata, the heat demand is not fulfilled, so there is a significant need for the energy consumption increase. The public sector is constrained in this case by the budget limits, but tends to increase its consumption too, especially for the sectors, where the indoor climate is important: schools, kindergartens, hospitals.

- Policy barriers

In the developing countries there is still an insufficient interest and therefore enforcement of the energy efficiency at the governmental level; subsidized energy tariffs create a disincentive for the consumers to implement energy efficiency measures; the lack of qualified personnel and decision-makers; bureaucracy and corruption.

The CDM-specific barriers to energy efficiency are mainly repeating the same categories, but I would like to focus on the particular 3 barriers, which are specific for the CDM, and especially for energy efficiency in households, involving fuel switch measures and one barrier, which is specific for public buildings.

3.3.1 Transaction costs

The transaction costs theory was developed by Ronald Coase in 1932 when he was giving a lecture at the School of Economics and Commerce in Dundee, Scotland. Ronald Coase described this theory in 1937 in the paper "The Nature of the Firm" (Coase, 1991). Later in 1960 in his article "The Problem of the Social Cost" Ronald Coase explains the nature of the transaction costs: "In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on" (Coase, 1960, p. 15).

Small-scale projects are generating smaller amounts of emission reductions than large-scale projects, thus unable to rely solely on the revenue stream from emission trading (Wang et al., 2003). Taking into account the fact that most of the registered projects have also low financial attractiveness, any additional costs can prevent the project to enter the pipeline.

Transaction costs include those costs, absence of which would not result in higher emissions, if the project is implemented. This means that bearing such costs does not result in additional GHG emission reductions, generating no additional revenue (Chadwick, 2006). However, without such costs, the CDM project would not be initiated and registered. CDM transaction costs include the following categories ("degressive" in the list means "decreasing with the increase in the project scale") (Michaelowa et al., 2003):

- Search costs: fixed costs for searching partners for the projects;
- Negotiation costs: degressive costs of the project design document preparation and public consultations with the stakeholders;
- Baseline determination costs: fixed consultancy cost of the baseline development;
- Approval costs: fixed costs of the project approval from the Designated National Authority;
- Validation costs: fixed costs of the review of the PDD by the Designated Operational Entity;
- Review costs: costs of reviewing a validation report by the Executive Board;
- Registration costs: fixed registration fee paid to the EB;
- Monitoring costs: fixed costs to collect real performance data;
- Verification costs: degressive costs of verification of the monitoring results by the DOE;
- Review costs: costs of reviewing the verification report by the EB;

- Certification costs: degressive cost of issuance of the CERs by the EB;
- Enforcement costs: proportional costs of the administrative and legal measures in the case of deviations from the agreed transaction;
- Trading costs;
- Transfer costs;
- Registration costs: costs of an account in the national registry.

The pre-operational or up-front transaction costs are those costs, borne before the project commissioning (in the list: all costs before monitoring costs). According to the Prototype Carbon Fund (PCF - a carbon finance unit at the World Bank) the pre-operational costs are estimated at 265 000 USD, while EcoSecurities estimated the minimum up-front cost in 2002 for a CDM project at 80 000 USD. The simplified procedure for the small-scale projects cut these costs by 67% according to EcoSecutiries (UNEP, 2004b). Table 3-1 shows the estimates for the transaction costs in the recent literature:

Table 3-1 Transaction costs for large- and small-scale CDM projects according to recent studies

Study from recent literature	**Pre-implementation (USD)**		**Implementation (USD)**	
	Large-scale	**Small-scale**	**Large-scale**	**Small-scale**
PCF (2003)	265 000	110 000	45 000 – 70 000	7 000 – 20 000
Mariyappan et al. (2005)	71 000	28 400 122 500, if bundled	132 000	30 000 48 000, if bundled
Walsh (2000)	100 000 – 500 000	40 000 – 80 000	10% - 20% of pre-implementation	10% - 20% of pre-implementation
Martens et al. (2001)	For small-scale solar heating: 20% of CERs value 50% higher, if no simplified procedures			
Michaelowa and Jotzo (2005)	Large- scale total: 0.1 – 1 per t CO2; Small-scale total: 10 – 1000 per t CO2			
De Gouvello and Coto (2003)	Large- scale total: 100 000 – 1 100 000; Small-scale total: 23 000 – 80 000			

Source: constructed using data from indicated literature sources

The studies give a variety of costs depending on the types of projects, their scale, amount of CO2 emission reductions generated, length of the credit period, Designated Operational Entities involved in the project cycle, carbon finance institution, if any, and agreement type, complexity of baseline study and monitoring, number and complexity of consultations, frequency of verification, etc (Michaelowa et al., 2003; IETA, 2006).

Increase in transaction costs may arise from other barriers, one of which is the monitoring barrier of dispersed consumers. In order to reduce fixed costs small scale projects use bundling of the project activities in one project design document. However, this incurs higher monitoring and verification costs due to high fragmentation of the project activities and the CDM requirement to submit monitoring data for each of the project activities in the bundle (Kumar et al., 2004). With this barrier some other aspects are associated, like weak methodologies, information and data barriers, etc (Cheng, 2008).

3.3.2 Market risks

The energy conservation measures are effective due to installation of the new and more efficient appliances or improving the performance indicators of the building envelope. There are hidden costs of implementing any new technology. In case of a decentralized fuel switch (building's boiler) it is more obvious: if market price for the new technology fuel increases, this means increase in total spending, possibly preventing the system to generate savings. If the energy budget of the building is limited to a certain amount, the fuel consumption has to be limited too or even decrease, leading to no improvements in the indoor climate. One of possible solutions can be implementation of the demand-side improvements (as opposed to the supply-side, which fuel switch in reality is). End-use efficiency has the direct proportional relation with the fuel prices: the higher is the price, the larger are the savings.

In case of the CDM, the CERs prices are also presenting a market risk for a project's financial performance. If the project's profitability is dependent on the assumed revenue from the CERs and it is the only revenue, the project might be at risk. The figure below represents projects with a different profitability and CERs implications. The eligibility of the projects is defined upon the economic additionality. It is easy to understand what would happen to the profitability of the project with the CERs revenue in column 4, if the NPV of the CERs revenue were reduced due to a price change: it will become unprofitable (Chadwick, 2006).

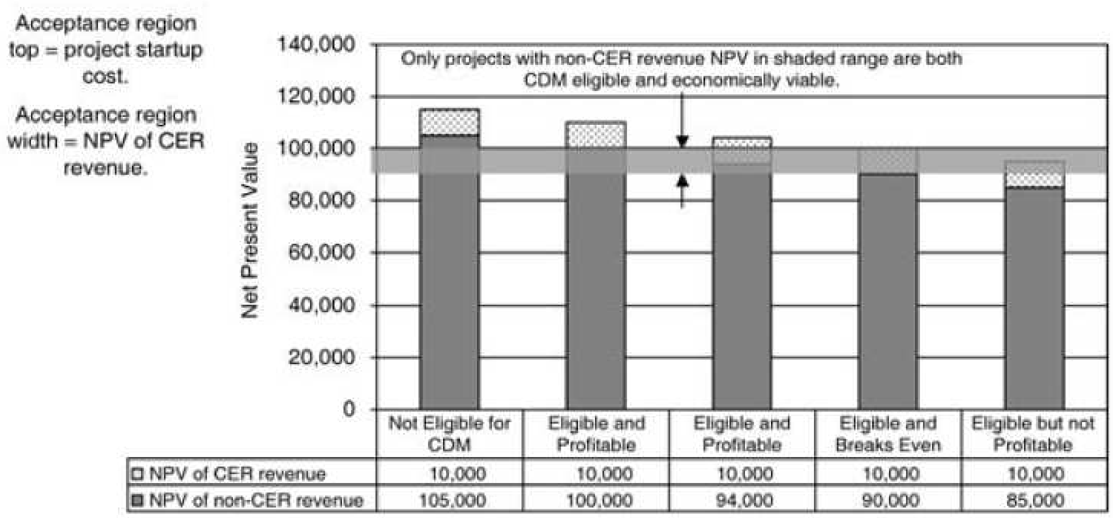

Figure 3-6 Variations in CDM project profitability and eligibility based on CERs revenue

Source: Chadwick, 2006

The prices for the CERs are very speculative. CERs are traded in three different markets: voluntary market, allowance market and a project-based system. Projects which belong to portfolios of the carbon finance institutions, such as the Prototype Carbon Fund, or programs, like CERUPT, experience different prices set in the respective agreements.

Usually, the prices range from 3 to 5 USD per CER in such projects (UNEP, 2004c). The price varies depending on the type of project, technology used, presence of the governmental guarantee, level of risk, degree of social benefit (UNEP, 2004b).

3.3.3 Suppressed demand and rebound effect

In the developing countries most of the households' energy consumption is below the heat demand frontier. They simply cannot afford consuming enough energy to meet their demand. More efficient installations and operation would reduce the use-phase costs and provide for increase in energy consumption. Increased consumption may result in the negative emission reductions, making such project ineligible for the CDM under the environmental additionality requirement (Thorne and Mqadi, 2003).

In 2000 a consultancy company in South Africa "SouthSouthNorth" developed a concept of a suppressed demand baseline for the thermal insulation measures in the low-income households in Kuyuasa, South Africa. The concept establishes the baseline for the project at a level of energy consumption in the absence of the suppressed demand, that is at the level of the fulfilled heat demand. The emission reductions in this case are equal to the difference in the energy consumption before and after the thermal insulation at the indoor temperature which satisfies the household's needs (UNFCCC, 2005; Mqadi and Malgas, 2004).

The Modalities and Procedures, in paragraph 27, state: "The baseline for a CDM project activity is the scenario that reasonably represents…emissions that would occur in the absence of the proposed project activity"; while in paragraph 36: "The baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party" (Thorne and Mqadi, 2003). These statements were used by the Kuyasa project designers to incorporate the increase in the projected emissions into the baseline scenario.

The approach was innovative and approved by the Executive Board for this particular project. However, the baseline chosen in this case is purely theoretical, increase in the energy consumption for such low-income households may happen well after the end of the crediting period (UNFCCC, 2005; Mqadi and Malgas, 2004). Overestimation of the baseline emissions for the Kuyasa project was justified by the extremely low energy consumption and insignificant potential emission reductions, while project had significant potential to contribute to the sustainable development. The suppressed demand model was used in the Kuyasa project to increase the emission reductions to a viable level, due to the extremely low energy consumption (Cheng C., interview on June 2, 2008). In order to give a way to the CDM projects in South Africa, the suppressed demand baseline approach was accepted for this project.

Inclusion of the suppressed demand in the baseline scenario is very important for the achievement of the sustainability goals under the CDM in the developing countries. If the suppressed demand is accounted to its full extent, the credit is given in such projects for the "emissions avoided due to poverty and suppressed demand" (Thorne, 2001). In his presentation at the side event of COP 7, Michaelowa (2001) noted that projects addressing the suppressed demand generate income for poor and create a possibility to afford consumer good and services, including better energy supply. He outlined three types of suppressed demand projects:

- energy services: efficient supply and transmission, renewable energy, or cleaner fuels;
- goods: efficient appliances or efficient production processes;
- transport: efficient infrastructure or vehicles.

Increase in the energy consumption due to the improved energy efficiency and therefore decreased energy cost is called “a rebound effect”. The rebound effect is a phenomenon of the economic theory, which was first described by Staneley Jevons in 1865 when he noticed that a new and more efficient steam engine led to decrease in the coal price, which triggered a higher demand for coal (Gottron, 2001). In conditions of the suppressed demand the rebound effect can significantly reduce savings generated by the energy efficiency projects. For some demand-side energy efficiency projects the energy savings have been reduced by as much as 75% due to the rebound effect (Shrestha and Timilsina, 2002). Depending on the level of the demand suppression and amount of potential savings, efficiency projects in such conditions may result in no savings due to the demand for the higher energy consumption.

3.3.4 Split incentive and budgetary contraints

The split incentive in the households can be explained by a difference in the interests of those who own the building and those who use it. The owner is the one who is expected to invest into the housing improvements; the user is the one who would get the savings on the bill. If the owner and the user were the same entity, there would be no discrepancy (Koeppel and Urge-Vorsatz, 2007).

In the case of the public buildings, the split incentive is trickier. It depends to a large extent on the national regulations on the public finance. The public institution is limited by the budget constraints. The budget is accorded to the institution by the municipality, whose budget is also controlled by the central authority. If in year 1 the municipality undertook some energy saving measures in a public building, which it owns, in year 2 the budget line subsidizing energy consumption will be cut exactly by the amount of savings. Thus, undertaking the investments, the owner and the user cannot benefit from the savings; instead, these savings are returned back to the budget of the central authority and redistributed to those activities which need more financing. If the municipalities owning the public buildings were independent of the central authorities (district, Ministry, government), then there would be no split incentive (USAID, nd, 2006).

In the case of the budgetary constaints the energy efficiency projects lose its economic attractiveness represented by the generated savings. If the governmental control over the municipal budget is too strict, there is no incentive for the municipality and a public building to carry out the activity. On the other hand, if there is a possibility for more flexible budget management (for example, as a result of a special agreement or change in the state regulations), the savings can be used by the municipality for own purposes, one of which may be acquisition of more energy services, in case of the unfulfilled demand.

In case the restriction on the savings retention exists, but the repayment of the loan borrowed for the project implementation is subsidized, the project would be implemented, but will not achieve its sustainability goals. If the savings are not to be used for the loan repayment and should be given back to the central budget there is no possibility for the public institution to improve the indoor comfort, if there is a shortage in the energy service (EnEffect, 2001).

The budget execution and regulations on the public financing are closely related to the issue of the suppressed demand. Strict regulations and control over the allocations create disincentives for participation and do not contribute to the sustainable development goals under the the CDM provisions. The municipal autonomy creates more flexibility in the use of the generated income; however, in this case the issue of the rebound effect should be carefully addressed. The possibility to spend the savings on the increased energy consumption improves the social aspect of the public institutions, but within the framework of the CDM it results in the environmental underperformance.

3.4 Summary

Literature review contributed to answering two of the research questions:

- How is the performance of the CDM project defined ex-ante?
- What market and policy conditions exist to the financial and environmental performance of CDM projects on energy efficiency in households?

Based on the reviewed literature the ex-ante performance was defined as the baseline setting and additionality demonstration; some implications of the economic additionality justification were presented for the small-scale CDM projects collected in the course of the literature review. The literature review helps the reader identify the common barriers to energy efficiency in households and choose among them the ones that would be relevant for the CMD case study on energy efficiency and fuel switch in public buildings in Moldova: the suppressed demand and the rebound effect; the budgetary constraints and the associated split incentive; the market risks due to fluctuation of the market prices for the fuel and CERs; and transaction costs. Partially, the literature review contributed to answering the question about the possible impacts of the barriers on the project's financial and environmental performance; however, such estimates are rather qualitative.

Further the research is structured according to the research questions and the methodology. After reviewing the literature and answering two of the research questions the study proceeds with the analysis of the documentation for a practical illustration of the CDM project on energy efficiency in households and assessment of its performance with the alternative scenario building and sensitivity analyses against the barriers identified through the literature review.

4 Case study: Moldova Energy Conservation and Greenhouse Gas Emissions Reduction Project

4.1 Heating sector in Moldova

Moldova is very limited in its natural energy resources. Therefore it is largely dependent on the imported fuels from Ukraine and Russia. The centralized electricity and heat production is fully based on the natural gas.

Since the collapse of the Soviet Union the energy system in Moldova has been experiencing a lot of technical, financial and managerial challenges. The district heating systems became obsolete and deteriorated, with the low supply and distribution efficiency. Historically, the district heating was supply-oriented, offering low flexibility to the consumers. For instance, individual apartments in the cities still cannot regulate their heat consumption by using valves, if they are connected to the district heating.

Due to financial difficulties the consumers were reducing their heat consumption and by 2004 it constituted only 20-40% of the consumption level of 1990 (USAID, 2006). Such changes in the consumption pattern made the oversized heating system costly and inefficient. Most of its users started disconnecting from the district heating and installing the individual gas-fired boilers. Individual heating systems offered flexibility in controlling the system, better thermal comfort, higher efficiency and less operational costs in the use phase. However, the initial investment in such a system is usually high and cannot be afforded by each consumer.

Functioning district heating systems now remained only in big cities: Chisinau and Balti; although individual heating systems per apartment or house are also widely used in these cities. All smaller municipalities and rural areas either do not have heating systems at all or consumers in these areas installed coal, gas, wood or heavy fuel fired boilers for the individual heating. Some buildings use electricity to heat the areas individually.

Public buildings, such as schools, kindergartens, hospitals and cultural institutions are heated individually. Municipal authorities or other institutions owning the buildings (the Ministry of Education or the Ministry of Health) allocate the resources for the heating needs in such buildings annually. They are also responsible for allocating the financing for renovation and other improvements. However, municipalities are very limited in their financial capabilities. Most of the public budget is allocated for the salaries. 20-40% of the budget is allocated for the energy expenditures (USAID, 2006). Only a small portion of the budget is dedicated to renovation or reconstruction activities. Thus, efficiency improvements, especially requiring large initial investments, are a heavy cost burden for the public buildings.

Municipalities are dependent on the central budgets. Since 1999 according to the Law on Public Finances the municipalities can take commercial loans, however, there is a limit on annual reimbursement of loans of 20% of the total budget revenue for the given year (USAID, 2006). Another large disincentive to implement measures aimed at a higher efficiency and savings is the inability to keep or use savings for own purposes by the municipalities. The generated reductions in costs are automatically subtracted from the next year budget for the same institution, thus creating a strong disincentive for any energy saving activity (USAID, 2006).

4.2 Energy II Project

In 2003 the Government of Moldova elaborated a National Program for Energy Conservation for the period 2003 – 2010 and a new Energy Strategy until 2020 that focuses on the more efficient, competitive and reliable national energy industry, at the same time ensuring the energy security, upgrading of the energy-related infrastructure, and improving energy efficiency, etc (UNDP and ME, 2000; Comarov P., interview on July 17, 2008).

According to the Strategy, the most important tasks of Moldova in the energy sector are:

- ensuring the energy security of the country;
- implementation of the real measures for the power market liberalization with the view of integrating Moldova in the European energy system;
- increase in energy efficiency of the production, transmission, distribution, and consumption of energy resources;
- introduction of renewable sources of energy, where economically reasonable.

The improvement of efficiency in the energy sector assumes a reduction of the greenhouse gas emissions and contribution to the environmental improvements, such as air quality improvement. The action plan for the National Strategy foresees the reduction of a share of coal in the energy production by maximum 5% and the correspondent increase in the use of natural gas and growth of energy efficiency in the energy production by maximum 5% and in the small combustion sub-sector by 10% by 2010 (UNDP and ME, 2000).

The Energy II Project proposed in 2003 has the objectives in line with the National Energy Strategy. It foresees an upgrade of the electricity systems, improvement of the heating supply and efficiency, and technical assistance to the energy policy reforms.

The CDM project on Energy Conservation and Greenhouse Gas Emission Reductions in Moldova has been based on the on-going Energy II Project financed by International Development Agency (IDA)/WB and Swedish International Development Agency (SIDA) (UNFCCC, 2006). One of the objectives of the Energy II Project includes improvement of the heating efficiency in the selected public buildings in different districts of Moldova. A total of 80 buildings in 8 municipalities were planned to participate in the project. By 2008 the heating systems have been upgraded for 35 public institutions and a number of residential buildings. The legal and institutional framework in Moldova did not let the project include residential buildings and other commercial users in the list of beneficiaries. However, those historically connected to the heating supply of the nearby public objects residential buildings are not allowed to be disconnected from the renovated heating system.

The majority of selected buildings are located in the small municipalities or rural areas of Moldova. All of the beneficiaries are public institutions financed from a municipal, district or governmental budget – schools, kindergartens and hospitals. The main activities within the heating upgrade component of the Energy II Project include replacement of the existing boilers, switch of the existing fuels to the natural gas, improved thermal insulation of the heat distribution grid and the building's heating systems, installation of the new automatic substations and metering equipment. In some of the buildings besides the heating system the hot water supply system has been improved. The total amount of the credit for the heating component is 9.8 million USD (WB, 2003).

The financing for the heating component is lent from the Ministry of Finance as portions of IDA credit as direct loans to municipalities with a guarantee from the district authorities, or as a loan to the district authority with the subsequent lending to the municipality. Because of limited financial capability of the municipalities, the loan is subsidized for the local authorities or project beneficiaries by the Ministry of Finance according to the IDA terms (UNFCCC, 2006).

The decision to implement decentralized heating systems based on the heat-only-boilers for the public buildings has been based on the outcomes of the report prepared by the WB and SIDA in 2001. The report states that decentralized heating is the most affordable and thermally comfortable alternative to the deteriorated district heating in municipalities of Moldova. Centralized systems are deteriorated, oversized and very inefficient. However, the total investment cost for the decentralized systems is higher than for the centralized or semi-centralized; although in the long-run the decentralized systems are more cost-effective and offer a greater flexibility to the consumers. Semi-centralized heating has been suggested for the districts with the higher density of consumers, where the losses could be minimized, like in Ungheni.

The project is carried out in packages. The first package was completed by 2003 and consisted of a pilot project on installation of the gas-fired heating boilers and rehabilitation of pipes in a semi-centralized heating system in Ungheni. Within the framework of the project 14 house boilers were installed for a number of public buildings and historically connected to the district heating residential buildings located nearby (USAID, 2006).

The second package included installation of the individual gas boilers and renovation of the heat distribution grid in the districts of Floresti, Straseni and Cantemir (see map of Moldova in the Annex A). The third package included activities in the districts of Leova, Nisporeni, Briceni, Falesti and Ialoveni. The project agreement foresaw a local municipality contribution for each of the districts, which would vary depending on the municipality's financial capability (Comarov P., interview on July 17, 2008). In Floresti, for example, the local contribution was up to 10%, including gasification of the objects and engineering works. In some of the districts, the municipalities also sought financial aid for the energy efficiency improvements on the demand-side, which were not to be financed through the Energy II Project. In Floresti the demand-side energy efficiency measures included replacement of windows and doors for the project buildings. The investments for these activities were undertaken by the private entities and the state (Tsap, 2006).

The project results were (Tsap, 2006):

- Increased indoor temperature from 13-15 C to 18-20 C;
- Reduced cost of the heat supply by 30 – 50% ;
- No need to have prolonged winter holidays;

- Possibility to run activities in public buildings, such as cultural institutions, during winter too;
- Significantly cleaner exhaust from the boilers. Most of beneficiaries noted that the snow near the buildings is not as dirty as used to be when coal was used as the heating fuel (Braga D., interview on July 14, 2008).

There have been no studies on the value of the external benefits, such as reduction/elimination of the lost schools days, reduction of the illness incidents, improved education and health care.

4.3 Case study: Moldova Energy Conservation and Greenhouse Gas Emissions Reduction Project

27 out of 35 institutions were selected to participate in the CDM project on Energy Conservation and Greenhouse Gas Emission Reductions in Moldova (hereafter Moldova CDM Project). The project activities generating emission reductions are implemented under the Energy II Project, while the monitoring of GHG emissions is performed by the Carbon Finance Unit Moldova (CFU) (CFU, 2006).

The reason for participation in the CDM can be explained by the financial barriers existing in the Energy II Project. Project beneficiaries are budget institutions with limited resources to reimburse the credit. Most of participants were reluctant to bear the full cost of the project. In order to keep the project's scale the Community Development Carbon Fund (CDCF) of the World Bank proposed to include a CDM component in the project that would generate certain revenue from the emission reductions that would partially cover the project costs for the beneficiaries (Gastelumendi J., telephone interview on July 7, 2008).

Due to the changes in the initial activity plans within the Energy II Project some of the participants dropped out from the project, 8 of them were also beneficiaries of the CDM component. This resulted in reduction of the number of beneficiaries to 19 (see Annex B) (Drucioc S., interview on July 14, 2008).

The project activities started a year later than planned, due to the project approval in 2005 and subsequent registration in 2006. Therefore, the changes in the energy consumption and emissions reductions had been recorded starting in January 2006. Besides, implementation of the Project Activity 3 was postponed until 2006, while the Project Activity 6, for which works were planned for 2006, had undergone the implementation with the rest of the Project Activities (PAs) in 2005 (CFU, 2007).

Figure 4-1 Leova District Hospital. Old boiler

Source: MEPIU, 2008

Figure 4-2 Leova District Hospital. New boiler

Source: MEPIU, 2008

Figure 4-3 Nisporeni District Hospital. Old substation

Source: MEPIU, 2008

Figure 4-4 Nisporeni District Hospital. New substation

Source: MEPIU, 2008

The project is planned to be extended with a new credit line disbursed in 2008 by WB through IDA. The implementation unit of the Energy II Project – MEPIU - has been visiting the potential beneficiaries of the project for selection of the buildings. The criteria for selection include the building's ownership, heated area, the scale of the needed investment, building's design (Comarov P., interview on July 17, 2008). The new project will also apply for the CDM (Drucioc S., interview on July 14, 2008). In Figures 4-5 – 4-8 below are illustrated objects of the potential participants in the extension to the Energy II Project: a school and a kindergarten in the town of Soroca. The school has an old boiler house in the basement, which is not functioning. The kindergarten has a similar boiler house which is out of date, while heating is provided by several wood-fired stoves located in the premises.

Figure 4-5 Soroca secondary school. Non-operating substation

Source: Irina Costromitcaia, field trip, July 17, 2008

Figure 4-6 Soroca secondary school. Non-operating bioler

Source: Irina Costromitcaia, field trip, July 17, 2008

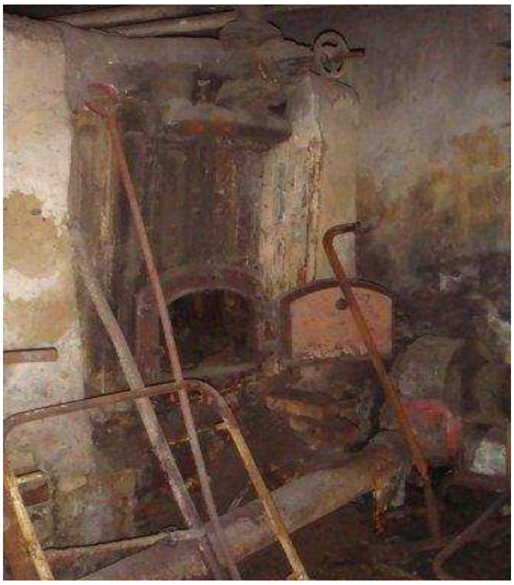

Figure 4-7 Soroca kindergarten. Old boiler

Source: Irina Costromitcaia, field trip, July 17, 2008

Figure 4-8 Soroca kindergarten. Wood stove

Source: Irina Costromitcaia, field trip, July 17, 2008

4.4 Additionality

In the case of Moldova CDM Project, two categories of activities are implemented within the project framework: II.E. “Energy efficiency and fuel switching activities in buildings”and III.B. “Switch of fossil fuels”. Both of them include supply and/or demand-side energy efficiency and fuel switching measure. However, if the main activity is energy efficiency then the project falls into the category II.E, if switch of fuels – category III.B. The categories set limits for the scale of the projects. The category II.E. allows aggregate energy savings in the amount not bigger than 15 GWh/year. Project activities under the category III.B. have to contribute to the emission reduction and altogether emit less than 15 kilotons CO2e/year (UNFCCC, 2007b, 2008b, c; UNFCCC, 2006). Such limits possibly exclude the potential beneficiaries, which otherwise need to be bundled in a new CDM project and apply anew for the approval and registration. However, this is time-consuming and increases the total costs, while for the typical buildings larger bundles and higher limits or no limits at all would be a better solution. Such an approach is suggested in the programmatic CDM for the small-scale activities.

For the category of retrofits in which the Moldova project falls, the baseline scenario should be based on the characteristics of the existing equipment, if the project stays within limits of the existing capacity/output/level of the energy service. For the increased capacity or a new facility, the additionality should be demonstrated using steps 1-3 of the “Combined tool to identify the baseline scenario and demonstrate additionality” (UNFCCC, 2007a), which is applicable for any type and scale of the project. Steps 1-3 include an assessment of alternative scenarios, barrier assessment and investment analysis, if applicable. Although the Moldova project activities include an increase in the capacity, inclusion of the suppressed demand, presented in the PDD, explains the increase in the output and demonstrates no use of the increased capacity during the crediting period due to a low consumption growth rate. This allows the project designers to stay within the requirements for the retrofit category and use only a barrier test to prove the additionality, thus cutting the transaction costs through the use of a simplified methodology.

In case that the suppressed demand is not included in the baseline scenario, the project might not pass the environmental additionality test. The simplified methodology for the baseline setting for the small-scale projects of the category III.B. assume the baseline scenario as the existing level of the emissions (UNEP, 2004b). Historically the energy consumption and therefore the emissions level had been decreasing since 1990 due to financial problems. The level of consumption in 2004 (reference year for the project) constituted only 10-40% of the required by the standard. The project scenario showed the increase in the consumption and respective emissions, due to the increased financial capacity and the existing unfulfilled demand for heating (UNFCCC, 2006). Therefore, if the baseline was constructed based on the current energy consumption in 2004 the emission level would be higher after the project implementation, generating no emission reductions. This will be further elaborated in the Section 5.1.

With the barrier test for the retrofits with a higher initial cost, the financial additionality of the CERs revenue is the one of the possible ways of demonstrating additionality, because in retrofitting, there is no additional revenue stream. Savings in such projects are comparably small. This approach was used by the Moldova project designers. The technical expert of the CFU Moldova, Mr. Dumitru Braga (interview on July 14, 2008), stated that some of the potential project beneficiaries, namely, public organizations, were not willing to participate in the Energy II Project having zero revenue stream. They correctly assumed the costs to be too high to afford on their own, while the credit reimbursement would most likely distract the budget allocations. Thus, the CDM was used as means to promote energy efficiency in the public building sector (Braga D., interview on July 14, 2008; Comarov P., interview on July 17, 2008).

Due to the fact that most of the public buildings cannot afford the initial cost, the credit scheme was used for implementation of the project, offered by IDA/WB. However, limited budget resources of the public buildings are unable to reimburse the full cost of the credit within the project period. Therefore, additional credits from the emission reductions were considered to secure the credit reimbursement. In the case of lack of revenue from the emission trading, the project would have reduced its scale, thus excluding a number of beneficiaries from the project (Gastelumendi J., interview on July 7, 2008).

In the end, unfortunately, a number of PAs dropped out from the project, due to reasons independent from the CDM project management. However, while the deliberate reduction of the bundle size would be done taking into account the financial impact of such an action, the drop out negatively affected the project results: the project lost more than 50 000 t CO_2 of the emission reductions (CFU and MEPIU, 2005).

To conclude, Moldova CDM project is a good example of an additional project, which clearly demonstrates using the CDM as means to overcome a financial barrier of the high initial cost to promote energy efficiency.

5 Case study analysis

5.1 Rebound effects

5.1.1 Suppressed demand

The baseline fuel used for heating of the PAs is coal, wood or heavy fuel oil combusted in the obsolete boilers and stoves with the efficiency range from 40% for stoves to 87% for heavy fuel oil boilers (see Annex B). Due to financial and infrastructural constraints the project beneficiaries could not afford the level of the energy consumption which would satisfy the demand and allow maintaining the normal indoor temperature over the whole heating period. The baseline level of the energy consumption constituted only 10-40% of the energy consumption level in 1990 (the standard level of heating) and the average heating period reduced by half from 6 months to 3 (UNFCCC, 2006).

If the project beneficiaries were consuming the amount of energy required to maintain normal heating conditions and the only reason for the lower temperature would have been losses due to inefficiency, the project might generate energy savings. However, the level of the energy consumption was constrained by the budget limits and installed capacity and was lower than demanded. Due to the annual growth of the budget subsidies for the public organizations between 4-10% on average, the increase in spending on energy is expected, thus raising the energy consumption as projected by 5% annually (CFU, 2006).

The growth in the energy consumption results in a longer heating period, higher indoor temperatures, increase of the heated area, if needed, and overall comfort and health benefits. This expected growth in the consumption patterns for the energy service is occurring due to the unfulfilled or “suppressed demand”.

The main idea of the suppressed demand baseline consists of avoiding the exclusion from the CDM of the energy improvement projects for poor, which result in the increased energy consumption after the project implementation. Low-income consumers (whether households, or as in the present case, financially constrained public buildings) usually cannot afford a normal level of energy consumption required to fulfill the needs for the energy service. Due to financial or infrastructural problems such consumers tend to keep their consumption level very low, much lower than demanded (Mqadi and Malgas, 2004). Implementation of an energy efficient technology saves energy and money for such consumers creating conditions for a rebound effect - consuming more energy and affording better comfort level.

Following the traditional CDM methodology for calculating the environmental additionality of the project, such increase in the energy consumption may exclude the project from participation in the CDM. The level of emissions in the presence of the project will most likely be higher than the actual emissions at a low level of the energy consumption, resulting in negative emission reductions and making such a project not additional and therefore ineligible for use of the CDM. The inclusion of the rebound effect in the baseline gives a possibility to compare the baseline and the actual consumption on fair grounds.

In the Moldova case, it was expected and calculated by the project designers that the same level of the heat consumption as in the reference year 2004 would not be kept throughout the crediting period. They did not use the notion of the suppressed demand and the rebound effect to describe the annual 5 % growth incorporated in the baseline scenario. However, inclusion of the increased consumption in the baseline due to the unsatisfied energy demand is reflecting the same idea.

If we take a look at the total embodied heat consumption for the 27 Pas, the amount needed to maintain the normal indoor temperature during the full-length heating season in 2004 (before the project implementation) is equal to 222 164 MWh, while after the implementation of the project this amount would be reduced to 123 066 MWh due to elimination of the losses and improved boiler and distribution efficiency. The actual heat consumption in 2004 was 54652 MWh (all the figures calculated based on the data from the CFU and MEPIU, 2005).

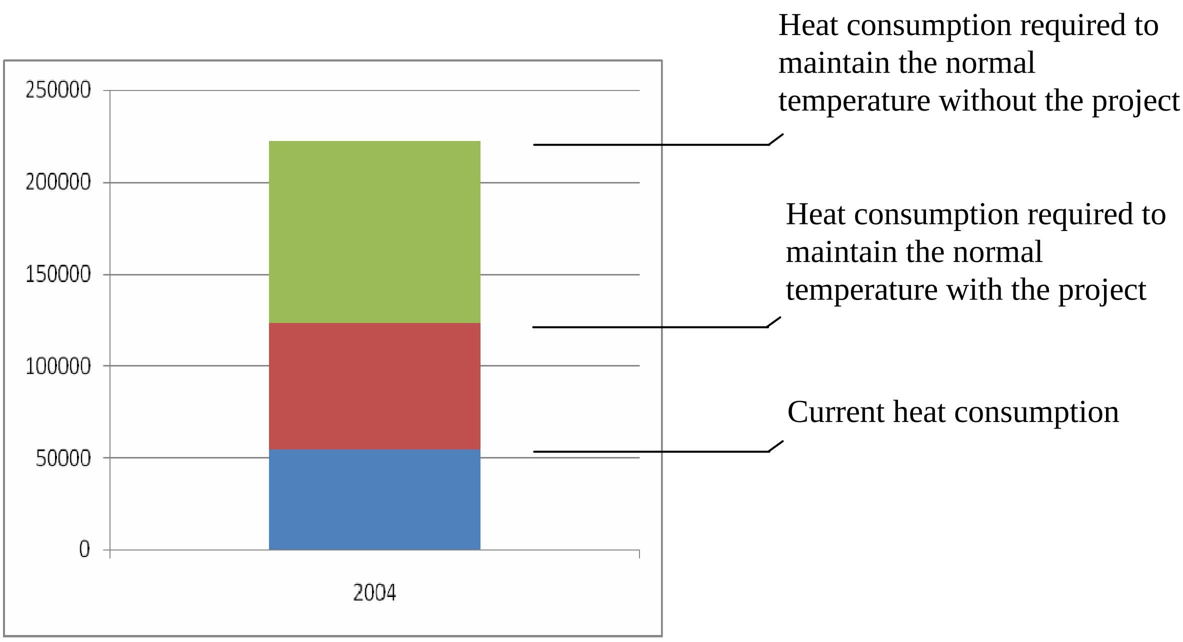

Figure 5-1 Suppressed demand

Source: calculated and constructed based on data from CFU and MEPIU, 2005

In order to find how much the consumption is suppressed in the project public buildings, it should be calculated the amount of the heat embodied in the fuel needed to provide for the normal heating conditions in the public buildings in case no project has taken place and if the project is implemented. Normal conditions satisfy the standard requirements for the heating season length of 4350 hours (6 months) and the temperature regime required for the given types of public buildings (18 – 21 C depending on the type of the building: school, kindergarten or hospital). The difference between the amount of the heat consumed for the normal indoor climate conditions without the project and after the project implementation constitutes the energy savings that the project would generate annually in the absence of the suppressed demand. After the implementation of the project this difference is lower due to the energy savings occurring as a result of the efficiency improvement measures (see Fig. 5-1).

So, assuming that sometime in the future the consumer will reach a required level of the heating we can project what would be the emission level if the demand is unsuppressed, both in the absence and presence of the project. The difference between these values will represent the emission reductions for the unsuppressed demand scenario. This approach clearly shows that even if the energy consumption is increased relative to the current level, the emissions are reduced compared to the emission level that might have occurred in the absence of the installed technology (Mqadi and Malgas, 2004).

While the normal consumption level maybe achieved far beyond the crediting period, it is very important to project the suppressed demand and the associated rebound effect correctly and set a realistic growth rate. If the actual growth rate is higher than it was projected, this would negatively impact the amount of the emission reductions generated.

The actual figures on Fig. 5-2 show that compared to the baseline consumption in the reference year 2004 (the actual measured data) the amount of the energy consumed by the 19 PAs grew by 28% in 2006, from 12 265 MWh to 15718 MWh, which means an annual growth rate considerably higher than the projected 5% in the model.

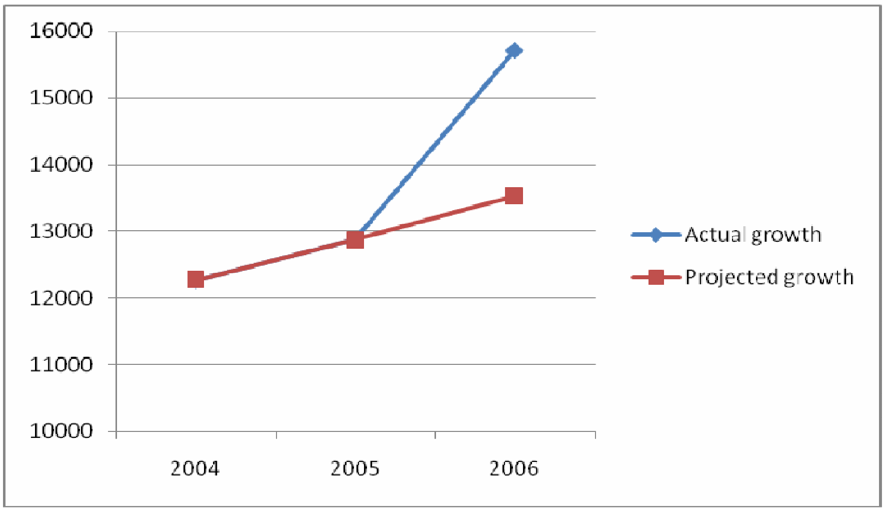

Figure 5-2 Projected and actual heat consumption

Source: calculated and constructed based on data from CFU and MEPIU, 2005; CFU, 2006, 2007

The 5% heat consumption growth estimate would lead to reaching by 2017 the energy consumption level at which the project beneficiaries would be able to afford the required by the standard 4350 hours of heating or a full-length heating season. An average annual growth rate of approximately 15% is needed to reach the energy consumption level needed for ensuring the normal indoor comfort by the end of the crediting period in 2015 (see Fig. 5-3). This growth rate most probably will not be maintained due to a steady increase in the gas price and the limits of financing provided from the regional and state budgets. Already for the first semester of 2007 the energy consumption decreased by almost 10% compared to the same period of 2006. This can be explained by the sharp increase in the natural gas price from 110 USD/1000 m3 in the first half of 2006 to 170 USD/1000 m3 in 2007 (ANRE, 2006, 2007). In its annual report National Agency for Regulation of Energy of Moldova (ANRE) (2008b) communicated that the consumption of the natural gas in

Moldova was reduced by 8.6% due to warmer winter and spring compared to 2006 and the increase in the gas tariff.

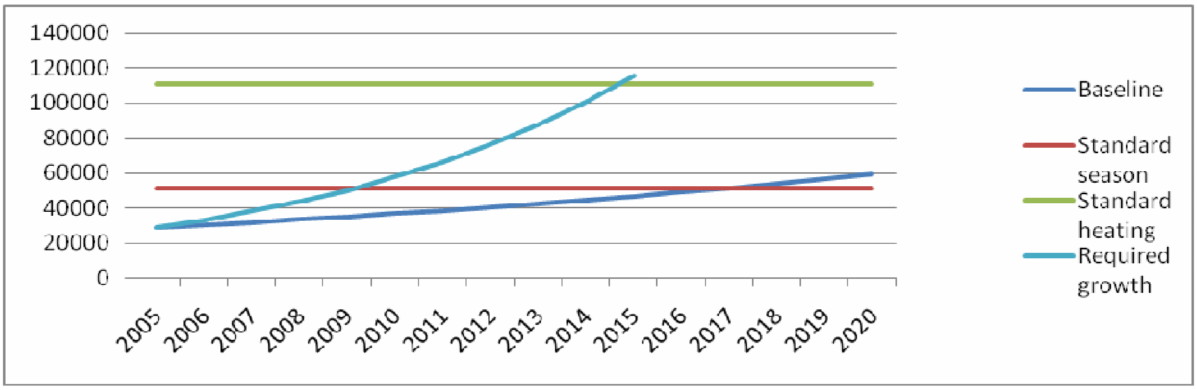

Figure 5-3 Scenarios for increasing heat consumption

Source: calculated and constructed based on data from CFU and MEPIU, 2005

The project model did not take into consideration that the prices for all fuel types would rise by more than 6% as expected in the baseline scenario. The real spending of the beneficieries on fuel in 2006 would be much higher than assumed by the baseline, according to the increased prices for coal (110 USD/t), wood (25 USD/m3), heavy fuel oil (300 USD/t) and natural gas (150 USD/1000 m3) (Bordeianu C., interview on July 14, 2008). While the cost of 1 MWh generated by coal is almost 20 USD and by heavy fuel oil is 28 USD, this is more expensive than by natural gas (16 USD) due to the transportation costs for the solid fuels (calculated using the data from Annex B). The fuel switch measures therefore cut the energy expenses for the 19 beneficiaries in 2006 in approximate amount of 350 000 USD (calculated based on the data from CFU and MEPIU, 2008). The sharp increase in the energy consumption in 2006 could be explained by the surplus of the financial means due to the fuel switch and the existing demand for the increased heating. However, public institutions usually face the problem of inflexible budget and inability to use the saved financial means. In the case of Moldova CDM project it is relevant to address these constraints in conjunction with the unfulfilled heat demand and the possible rebound effect.

5.1.2 Split incentive

The financial management of the budget institutions is limited to the itemized budgetary allocations from the central authority to the municipalities or directly to the public institutions (e.g. certain hospitals under the supervision of the Ministry of Health). Any savings occurring under a certain item cannot be used for covering shortages in other items, but has to be returned to the central budget. A next year allocation for the overestimated item will be cut, thus allowing for no savings for the public institution. Therefore, municipalities and public buildings are not encouraged to implement efficiency measures which generate savings. There are no incentives in a rigid system to reimburse loans from the savings or use the saved money for the main activities, for example, to use the economic savings from the efficiency improvements in a school to buy books for the school library (USAID, 2006; EnEffect, 2001).

The split incentive and the regulatory barriers are a general obstacle to energy efficiency, not specific to the CDM. However, if we consider the associated with the CDM environmental and social targets and the special circumstances of the suppressed demand and the potential rebound effect, the budget execution policy becomes very relevant for the assessment of the future performance of the CDM project.

Assuming a hypothetical ability of the municipalities to increase the budget expenditures for the purpose of the investment management, it would be possible to see what would happen to the energy consumption and the level of the emissions if the allocations for the heating stay the same for the respective year (keeping a 5% annual growth). Certainly, this is the maximum possible level of consumption, assuming no growth other than annual 5% can be afforded by the central authority (see Fig. 5-4).

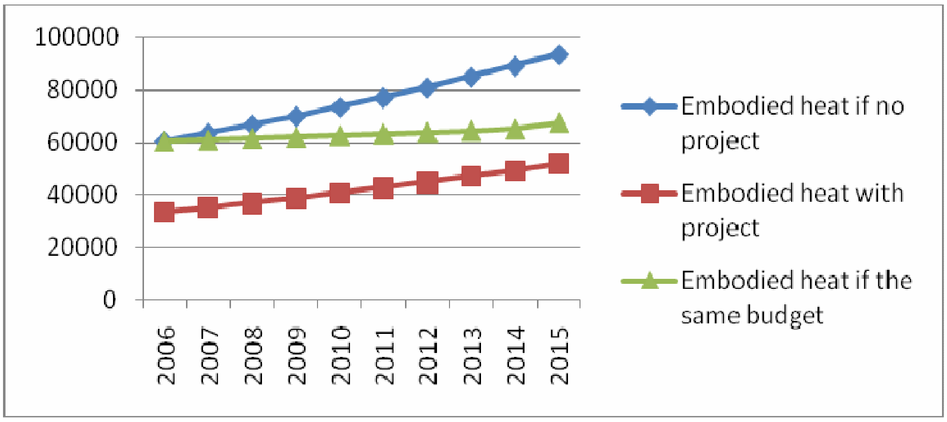

Figure 5-4 Alternative scenario for the embodied heat consumption

Source: constructed based on data from CFU and MEPIU, 2005

If the embodied heat consumption follows the red curve, it means no indoor temperature changes happened due to the project implementation: the final energy consumption (useful energy) follows the baseline scenario. If the actual embodied heat consumption is anywhere between the red and green lines, the temperature increased starting with the year of the project implementation, while no heating budget increase was undertaken for the respective year. While it is too early to speak about a tendency, Fig 5-2 "Projected and actual heat consumption" shows that the consumption does increase over the projected level for 2006. If the consumption follows the green line, it means that the total agreed baseline heating budget is spent by the buildings, while investment is not considered to be repaid from savings.

Full spending of the heating budget item might have happened if for example, the investment is fully subsidized by the government or accorded as a grant. In this case, there is no additional expenditure burden for the buildings. In order to preserve the allocated budget, their heat expenditures would grow according to the heat demand, available capacity and financial capability.

In the case when the loan has to be repaid, it is obvious that based on the financial capabilities of the public institutions, they would increase their consumption only to a level, which still generates savings enough to reimburse the loan, e.g. if the emission reductions are significant enough to generate net profit which can be spent on the increased heat consumption. The existing procedure for the budget execution, however, does not allow for the municipality to use their revenues freely moving them across the budget lines.

In order to allow for the project investments to be repaid by the municipalities, the procedure for the budget execution was altered in the agreement between the financing institution and the beneficiaries. The Subsidiary Loan Agreement between IDA and the municipalities signed within the Energy II Project foresees elimination of the risks associated with the financial management barriers. All municipalities are required to include the operating and debt service costs associated with the new investment as a separate line in their annual budgets. The amount of investment and the reimbursement scheme was pre-defined according to the ability of the municipalities to increase their budgetary expenditures. To minimize the risk of government reducing or eliminating subsidies for the heat consumption, it was secured that the government commits itself for the maintenance of the subsidies and aligns them with the budget revenues (WB, 2003).

The financial model constructed in the project design document shows the financial savings from the fuel switch and efficiency measures in the public buildings, which are used for the loan repayment. Being short of the needed annual savings to cover the whole investment cost, the project applied for the CDM to generate tradable CERs to cover the gap between the cost and revenue. The reimbursement of the loan is supposed to be undertaken based on the achieved energy savings and the revenue from the CERs. Such model estimates no shift in the energy consumption, except for a gradual increase of 5% as foreseen by the national policies, at least until the end of the loan repayment. This means that the indoor temperature increase is assumed to happen only gradually due to the annual budget increase and not due to the improved efficiency. In reality, this is not the case. Most of beneficiaries reported significant increase in the indoor temperature during the first year after the project implementation (Comarov P., interview on July 17, 2008). This can be explained either by the shift in the energy consumption or improved demand-side energy efficiency.

The shift in the energy consumption could not be incorporated in the project scenario by the project designers due to the existing baseline methodology for III.B. projects. The methodology foresees that the level of the useful heat consumption stays the same as in the baseline scenario. This is a clear deficiency in the project scenario accuracy. It shows no consideration of the suppressed demand and therefore excludes an important social effect of the project addressing insufficient heating. However, estimation of the consumption shift due to the rebound effect would be a very difficult task to complete. In any case, if the shift occurs (due to e.g. a subsidized loan, change in regulations, requirements to achieve the indoor comfort targets) the emission reductions resulting from project will decrease (Fig. 5-5)

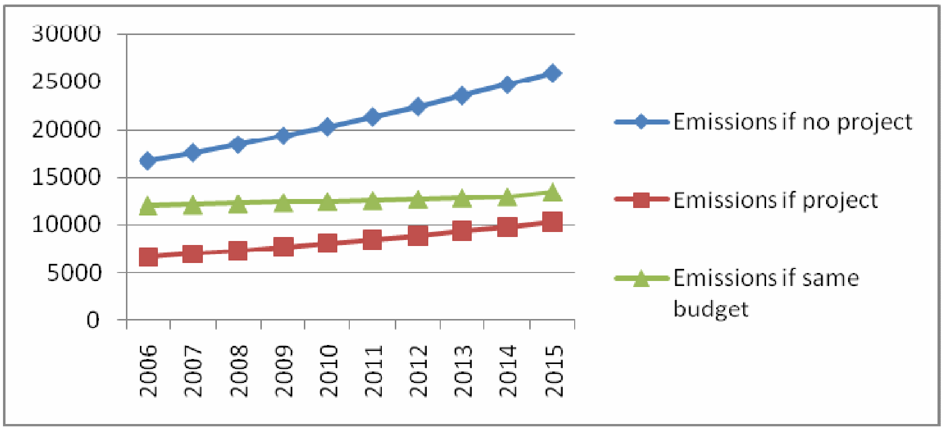

Figure 5-5 Alternative scenarios for CO2 emissions

Source: constructed based on data from CFU and MEPIU, 2005

At the level of the individual project activities (PAs) the changes in the consumption patterns are more diverse (see Fig. 5-6). The projected consumption for 2006 expected a 10% increase compared to the reference consumption in 2004 (CFU and MEPIU, 2005). However, for some of the project beneficiaries the consumption drastically decreased, while for others increased much more than projected.

The reasons for the increase in the energy consumption have been already discussed: the suppressed demand due to infrastructural and financial constraints - the baseline capacity was lower than demanded; the access to the energy source was limited; the savings on energy by heating less space or to a lower temperature. Almost all of PAs having no heating system due to its deterioration and using electricity for the heating purposes increased their consumption after the project implementation, because the electrical capacity was not enough to heat the building up to a normal condition. The reasons for the decrease can be explained by the consumers' way of maintaining a decent temperature using additional electrical heating as a point source of the heat. After the project implementation the efficiency raised and the need for the additional heating decreased (Comarov P., interview on July 17, 2008).

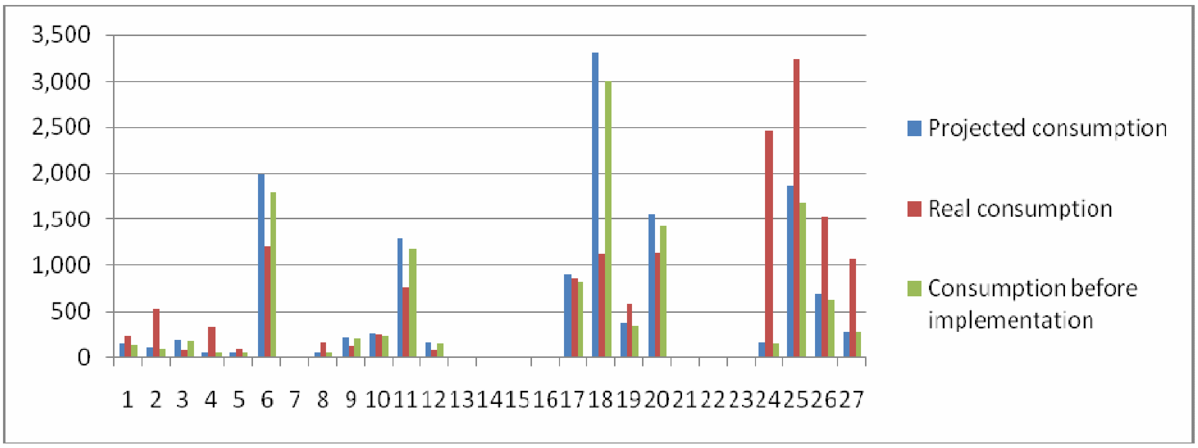

Figure 5-6 Heat consumption per project activity before project (2004), projected and after project

Source: calculated and constructed based on data from CFU and MEPIU, 2005; CFU, 2006, 2007

It should also be noted that the changes in the heat consumption depends largely on the financial capability of the public institution. The price for the natural gas increased by 45% in 2006 as opposed to projected 6% increase (ANRE, 2006). This fact could also to a large extent influence the consumption patterns in the buildings. Some of the buildings implemented demand-side energy efficiency measures outside the main project component, thus decreasing the total energy consumption of the building (Comarov P., interview on July 17, 2008). To conclude, if the useful consumption in the buildings decreases over time, this means either the energy users are trying to save on fuel decreasing the indoor temperature, or implement demand-side energy efficiency measures, like sealing of the windows and doors, and their useful consumption decreases with no decrease in the indoor temperature.

5.2 Cost-revenue analysis

The projected amount of the emissions for 2006 was 3801 t CO2 (due to that the implementation aof the PA6 was planned for 2006). The actual emissions after the project implementation constituted 3469 t CO2. If the works at PA6 were conducted according to the plan at the end of 2006, it would not generate emission reductions until 2007 and the figure for the actual emissions would be higher and constitute 4286 t CO2. Similarly, if not the implementation of the project at PA6, the emission reductions for the 19 PAs in 2006 would be lower than projected due to the increased fuel consumption compared to the projected (CFU, 2006, 2007).

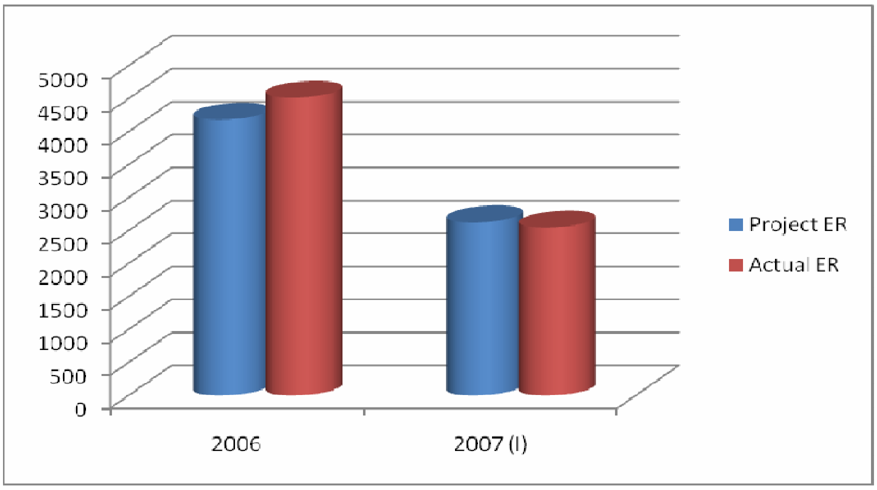

Figure 5-7 Projected and actual emission reductions

Source: calculated and constructed based on data from CFU and MEPIU, 2005; CFU, 2006, 2007

According to the design document the total discounted cost of the project over the crediting period would constitute 6 950 670 USD. This is 150 000 USD more than the planned baseline. The revenue from the CERs is expected based on a price of 5 USD/CER. This would result in a positive discounted net benefit for the project owners of more than 197 000 USD (UNFCCC, 2006; CFU and MEPIU, 2005).

IRR for the project without the CERs revenue is 9.2%, with the CERs revenue 10.2%. Sutter (2001) stated that for the private investors IRR should be not lower than 15% (including the international transaction costs) to get involved in financing of a CDM project. The transaction costs are not included in the calculations, because they have been excluded for the given project due to the provisions of the CDCF. However, starting in 2008, the project owners will pay 8% of their CERs revenue to the CFU Moldova for the monitoring activities (Braga D., interview on July 14, 2008).

Table 5-1 Financial indicators for 27 PAs

Financial index	USD
Total discounted project cost over the crediting period, USD	6 950 670
Total discounted baseline cost of the service over the crediting period, USD	6 799 481
Total project net benefit w/o CERs, USD	-151 189
Total discounted revenue from CERs, USD	347 068
Total project net benefit w/ CERs, USD	197 315
Cost of emission reduction, USD/t CO2	99.7

Source: UNFCCC, 2006; CFU and MEPIU, 2005

5.2.1 Sensitivity analysis

The registered average contracted price of the primary CERs in 2007 and early 2008 is approximately 13.6 USD, which is 24% higher than in 2006, while the minimum price is approximately 9 USD/t CO2 (WB, 2008). The growth in the CERs market price is connected to the oil price increase and the growing shortage of the CERs supply and therefore is expected to continue.

While the contract price for the 1 tCO2 of the emissions reductions in the Moldova project has been stipulated at the level of 4.6 USD/tCO2, the reflection of the market price changes in the future revenue from the CERs trading depends on the possibility for the CFU to negotiate the contract price dynamics. Carbon finance funds at the World Bank (the Prototype Carbon Fund, the Community Development Carbon Find and the BioCarbon Fund) rarely offer a contract price for the CERs over 5 USD/t CO2, including a premium for the sustainability impact and taking into consideration the exclusion of all preparation costs from the total project cost (UNEP, 2004b).

Assuming no other factor in the projected scenario changed but the CERs price, it is possible to see how the revenue stream from the emission trading changes and affects the project's NPV. In reality the price of the CERs constitutes 4.6 USD/t CO2, only 0.4 USD/tCO2 less than projected (CFU, 2007). At this price the project's NPV reduces by 14% (see Table 5-1).

Table 5-2 Financial indicators for 27 PAs at contract CER price

Financial index	USD
Total discounted project cost over the crediting period, USD	6 950 670
Total discounted baseline cost of the service over the crediting period, USD	6 799 481
Total project net benefit w/o CERs, USD	-151 189
Total discounted revenue from CERs, USD	347 068
Total project net benefit w/ CERs, USD	169 435
Cost of emission reduction, USD/t CO2	99.7

Source: UNFCCC, 2006; CFU and MEPIU, 2005; CFU, 2007

The project breaks even (zero NPV with the CER revenue) at the CER price of 2.17 USD/t CO2. At the CER price of 4.6 USD/t CO2 as stipulated in the agreement with the CDCF (all other indicators remaining unchanged) the project breaks even with the average annual emission reductions of 5348 t CO2.

Another big constraint to the realistic baseline modeling is the volatility of the fuel price. The Russian gas exporter started increasing the fuel price in 2006 by an average of 45% annually. This has not been foreseen in the baseline model. It is understood that such a discrepancy with the projected fuel price growth will negatively affect the project profitability.

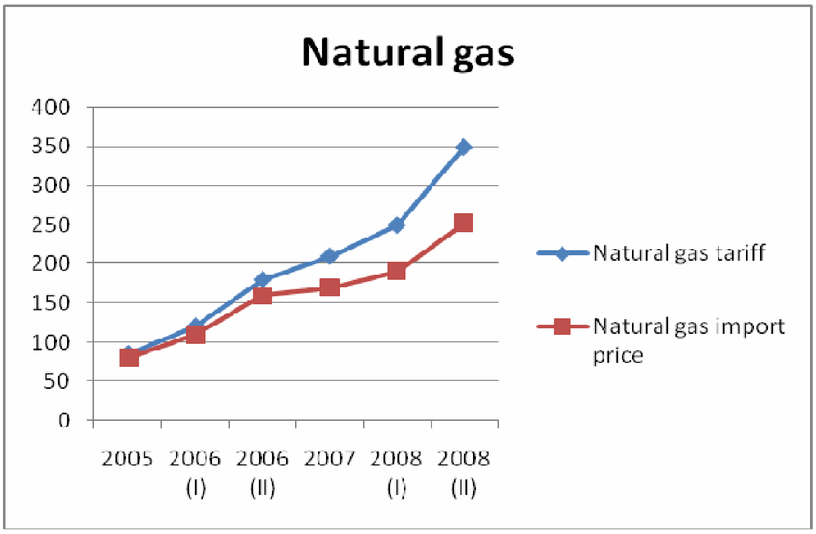

Figure 5-8 Dynamics of the natural gas import price and average tariff for final consumers

Source: constructed based on data from ANRE, 2005, 2006, 2007, 2008a; Monitorul Oficial, 2006, 2008

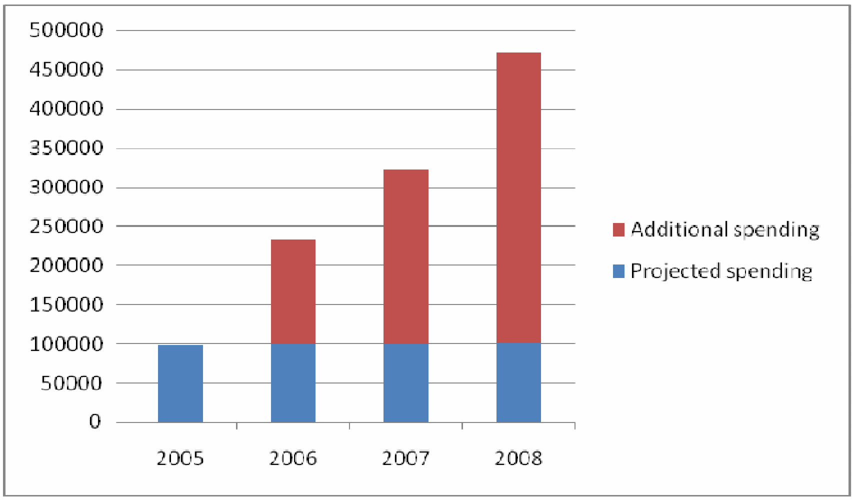

Figure 5-9 Dynamics of the discounted (10%) fuel cost for 27 PAs based on increased natural gas tariff

Source: calculated and constructed based on data from CFU and MEPIU, 2005; CFU, 2006, 2007; ANRE 2005, 2006, 2007, 2008a; Monitorul Oficial 2006, 2008

According to Fig. 5-9 the spending on fuel would grow considerably due to the increase in the natural gas tariff, if the level of the heat consumption follows the baseline scenario. In reality, the energy consumption in 2006 (first year after project implementation) was higher than projected (see Fig. 5-2). The fuel consumption for the 19 beneficiaries was respectively higher than projected by approximately 260 thousand m3 of natural gas; the budget spent on the consumed amount of fuel was by 162 000 USD (135%) larger in 2006 than planned for the 19 PAs (calculated based on the data from CFU and MEPIU, 2005; CFU, 2007).

The price for the natural gas exported by the Russian company Gazprom to Europe is gradually increasing too. Recent press release by the Chief Executive of Gazprom Alexei Miller (Pravda, 2008) acknowledges a potential increase in the gas price for Europe to 1000 – 1500 euro per thousand m^3. According to Gazprom by 2011 the price for the natural gas exported to the Former Soviet Union countries, including Moldova, should reach the European market price (Socor, 2007). Therefore the annual increase of 45% does not look very ambitious for the next several years.

This is how the financial indicators of the project change if the fuel price increase of the annual average 45% is introduced into the project cost for the whole crediting period (ceteris paribus):

Table 5-3 Financial indicators for 27 PAs at 45% fuel cost increase

Financial index	**USD**
Total discounted project cost over the crediting period, USD	20 463 126
Total discounted baseline cost of the service over the crediting period, USD	6 799 481
Total project net benefit w/o CERs, USD	-13 663 645
Total discounted revenue from CERs, USD	347 068

Total project net benefit w/ CERs, USD	-13 315 141
Cost of emission reduction, USD/t CO2	293.6

Source: calculated and constructed based on data from UNFCCC, 2006; CFU and MEPIU, 2005; ANRE, 2005, 2006, 2007, 2008a; Monitorul Oficial, 2006, 2008

If the data in the Table 5-3 reflected the real situation, the project beneficiaries would sharply reduce their fuel consumption in order to stay within the project budget. However, from the Fig. 5-2 we know that the heat consumption and the respective spending on it increased. This can be explained by the particularities of the method chosen by the project designers to demonstrate the investment additionality of the given CDM project. The method consists of a comparison of costs and does not include the revenue part of the project. It is assumed in such a method that the revenue stays the same for the baseline and project scenario. However, in the case of the Moldova CDM project, the revenue (heating budget) for the project scenario increased, as mentioned before, by 135%, allowing public buildings consume more energy, improve their living comfort and not increase their debt due to the increase in the gas tariff.

Therefore, the investment additionality demonstration as well as the financial assessments of the project performance should be based on the comparison of the NPVs of the baseline and project scenarios, rather than solely the costs.

5.2.2 Transaction costs

Transaction costs have not been included in the cost-revenue analysis, because they were excluded from the total project cost. All transaction costs are borne by the WB CDCF, which carries out the trading of the CERs in the market, until 2008, when project owners start paying the monitoring costs to the CFU in amount of 8% of the CERs revenue (Braga D., interview on July 14, 2008).

However, it might be interesting to see how comparable the transaction costs are with the expected revenue stream from the emission trading. According to Michaelowa et al (2002) the total transaction cost for a small scale project on the boiler conversion with the average emission reductions of 2000 – 20 000 t CO2/year constitute 10 euro/tCO2 (or around 15 USD/t CO2). If the project owners were paying the transaction costs themselves (assumed ceteris paribus), this would increase the cost of the emission reduction to 107.9 USD/t CO2 (discounted at 10% discount rate). The NPV of the project with the CERs will be negative: -374 542 USD.

According to the estimates for the transaction costs provided by the Prototype Carbon Fund of the World Bank (PCF, 2003) the pre-implementation costs for small-scale projects constitute 110 000 USD, while post-implementation range between 7 000 – 20 000 USD. Assuming the project owners bear all transaction costs, the net present value of the project would be reduced down to 39 435 USD, with the respective cost of reducing 1 t CO_2 equal to 101.6 USD. In 2008, the project owners are obliged to pay only monitoring costs, which constitute 8% of the CERs revenue, which would be equal to approximately 25 000 USD at the contract price of CERs for the whole crediting period. The cost of the emission reductions will grow up to 100 USD/t CO_2 (calculations are based on data from CFU and MEPIU, 2005; UNFCCC, 2006).

6 Conclusions and recommendations

The history of the CDM has not experienced so far a lot of projects targeting energy efficiency in public buildings. Therefore, there is yet a lack of practical studies addressing specific conditions under which the CDM projects in the public institutions are operating in the developing countries.

The biggest uncertainty with the CDM lies in its assumptive nature. The CERs are issued based on a simple calculation of the difference between what might have been emitted if no project had taken place and what really was emitted after the project was implemented. In the project design, however, the project emissions are also estimated, raising the magnitude of the uncertainty. Thus the actual project performance evaluated ex-post may be different from what was expected in the ex-ante evaluation of the project results. The discrepancy between the estimated and the actual performance may affect the project's contribution to the sustainability and the overall reasonability of the project implementation.

My contribution consists of an analysis of a number of the most common barriers to the financial and environmental performance of an energy efficiency and fuel switch project in public buildings, with the view of its participation in the CDM; and an evaluation of the possible consequences for the ex-post results of the project compared to its development scenario constructed ex-ante.

In order to know what to expect and what issues to address when designing a CDM project, a CDM project on energy efficiency and fuel switch in public buildings was taken as an illustrative example of an additional project in a sector rarely approved for participation in the CDM. This fact involves an interesting from the research point of view discussion of using the CDM as means to overcome significant barriers in implementation of the energy efficiency projects, especially in public buildings. At the same time the energy efficiency and fuel switch projects face a number of barriers and risks which are not always taken into account during the project design. Some barriers are specific to public buildings, which justifies the choice of the illustrative case study for the present research. Public buildings are also a very vulnerable sector in terms of their financial capability to implement projects that go beyond the business-as-usual.

The last, but not the least point is the uniqueness of the project. The CDM pipeline includes only 9 projects in energy efficiency in buildings, among which only 5 are registered. Two of these projects comprise a bundle of a large number of buildings. Finally, only one of these projects is focused on the fuel switch besides energy efficiency and on the public buildings as a target sector – Moldova Energy Conservation and GHG Emission Reduction Project, which is the selected case study for the thesis.

My findings (as qualitative assessments and tendencies, not precise quantitative estimates) can be extrapolated to other potential projects on fuel switch and energy efficiency in public buildings in Moldova and Former Soviet Union countries with a similar situation in the heating sector. Some of them, due to their common nature, can as well address private households and energy efficiency on the demand-side. For example, the rebound effect as a result of the suppressed energy demand and its impact on the greenhouse gas emission level can be addressed in any consumption sector, residential or public. The increase in the fuel market price reduces the financial benefits of the improved efficiency for the fuel switch projects, if the switch is from a cheaper to a more expensive fuel. On the other hand, for the demand-side energy efficiency measures the increase in the fuel price means an increase in the economic benefit. The volatility of the CERs price and variations in the composition and scale of the transaction costs bring uncertainty to the CDM project financing, evaluated in the present research. The only barrier specific for the public sector was the budgetary constraints, which are the consequence of a particular state policy on the public finance.

The findings of the research can be used during the project design stage in order to take into account possible obstacles and benefits that may influence further project performance and ensure the project against underperformance.

Energy efficiency projects in the developing countries often experience financial barriers. It is not always unavailability of funding, but more likely the weak financial status of the households, and especially budget institutions. Usually such beneficiaries can afford only loans under the very favorable conditions, like a long grace and reimbursement period, low interest, high subsidies, etc. Sometimes, the beneficiaries cannot meet the obligations for the own contribution, due to the shortage in the financial resources. Interviews with the experts of the Energy II Project revealed that some of the projects were delayed or refused due to inability of the municipalities to fulfill the requirement for the local contribution, such as infrastructure and engineering; although the degree of such contribution was reduced by the World Bank taking into consideration the financial constraints of the public institutions. Therefore, a claim of such projects as economically additional under the CDM is justified, even if they generate positive returns. However, the financial calculations should reflect the most likely scenario for justification, taking into consideration the most probable positive and negative effects of the market and non-market barriers on the baseline and project outcomes.

The barriers to energy efficiency projects, as well as the barriers specific for the CDM projects, are starting to be addressed in the negotiations and research among the CDM experts. The recent invention to address the small-scale projects, and especially energy efficiency in buildings, includes the programmatic approach to CDM. Programmatic CDM assumes a program of activities, which is implemented in order to achieve certain goals at a large scale, e.g. enforcement of the national policy. The activities under the program can be implemented at different times, in different locations, even not necessarily in one country (Oppermann, 2005; Figueres and Philips, 2007). Such an approach gives much higher degree of flexibility to the project designers. For example, in the Moldova case study the unexpected drop-out of several PAs resulted in a loss of 51066 t CO_2 of the potential emission reductions and a negative NPV for the project (CFU, 2006). More potential participants in the extended Energy II Project are identified; however, they cannot join the existing CDM project due to the procedural restrictions and need to be bundled into another project. Inability to expand the project activities at a later stage, when there is a need and demand for the project activities makes it necessary to apply for the registration of each bundle separately, incurring additional transaction costs. In case of the programmatic CDM it would be possible to add similar project activities, where the demand exists, at a later stage of the program implementation. This is called "the inclusion of the "long tail" projects", meaning the multitude of the small-scale projects, which generate small emission reductions individually, but represent a high reduction potential altogether (Hinostroza, et al., 2007). Unfortunately, the programmatic CDM does not yet solve the problems of the weak methodologies, demonstration of the additionality and the monitoring barriers. The baseline and additionality has to be proved at two levels, program and activity, thus, increasing the complexity of the procedure and costs for the information search and the development of the scenarios. Dispersed beneficiaries, with increased number and wider spread under the programmatic CDM, create monitoring challenges for the project managers. However, the more project activities apply for the programmatic approach, the more incentive is created to develop the standardized and simplified methodologies.

The split incentive in the public buildings is closely related to the existing regulatory framework in the CDM host country. The split incentive barrier arising from the budgetary constraints and absence of the municipal autonomy is a general barrier to any investment project, preventing any kind of borrowing for the public institutions. Such constraints are quite common in many of the Eastern European countries, like Bulgaria, Albania, Macedonia, and FSU countries, like Ukraine and Moldova. Subsidies do not work effectively, if there is no long-term incentive to implement a project, which generates savings. If there is a regulatory constraint on the local control and use of the generated revenues, the revenues do not benefit the investors. On the other hand, budget constraints set limits on the sustainability targets of the respective investment projects: savings, which otherwise could be used for a better indoor comfort, needed procurement and/or reimbursement of loans, would be simply cut off of the budget revenue under the currently prevailing regulations in some of the developing countries. One of the ways to combat this barrier is the adoption of the best practice approaches developed by some other countries, previously experiencing limited investment flow into the energy efficiency in buildings. Examples are a revolving fund for the energy savings created in Bielsko Biala in Poland and the regulatory changes, like resolution addressing budget execution in Lviv, Ukraine (USAID, nd).

The complexity and weakness of the existing methodologies is considered to be one of the biggest problems, needing an urgent address. Most of the barriers discussed in the present study are not considered by the standardized methodologies. For example, the suppressed demand barrier is difficult to overcome, if the baseline methodology does not allow a positive shift in the energy consumption. This leads to smaller or even negative emission reductions, making the project senseless from the point of view of the environmental additionality in the CDM. However, the increased energy consumption serves the sustainability goals of the CDM, which are sometimes prevailing over the emission reduction potential (IETA, 2006). The use of the standardized methodologies for small-scale fuel switch projects do not foresee the energy consumption increase, thus no increase in the indoor temperature is foreseen. However, this is the main purpose of the majority of supply-side energy efficiency projects. The households with the suppressed demand remain excluded from the CDM or experience worse performance of their projects, if no suppressed consumption is foreseen to be addressed by the methodology. Therefore it is reasonable to consider a development of new standardized methodologies addressing the impact of the specific barriers, thus attracting more projects addressing some important economic and social issues. On the other hand, there is a certain limit of how complex the methodology can be. More complex methodologies trigger higher transaction costs and may ruin the potentially eligible project. A methodology should not address all uncertainties and each specific circumstance, rather provide acknowledgement of the barrier existence and propose thresholds or benchmarks to incorporate the uncertainty impacts into the project design.

The underperformance (in terms of the thermal comfort) of the supply-side efficiency in the case of the imposed limits on the fuel consumption can be diminished if the demand-side energy efficiency is addressed. Battell (nd, cited in USAID (nd) studied the impact of 29 different investments on the CO2 emissions addressing different segments of the heating chain. The study proved that 1 million USD of investment in the end-use efficiency provides 3 times greater emission reductions than investments in the supply side. This can indicate that the supply-side investments may be made to increase the heat supply to consumers, rather than just for the energy efficiency purposes. It is obvious that savings on the supply-side are "wasted" on the demand-side if the building's thermal efficiency is low. The demand-side energy efficiency can potentially reduce about 20-60% of the end-use energy (USAID, 2006). Such measures like replacement or sealing of windows and doors, wall and roof insulation are low-cost and are much more cost-effective than the supply-side due to their direct impact on the useful energy. The energy experts of the Energy II Project were also questioning the single-side approach used in the WB project; however, it was explained that demand-side energy efficiency measures "are not foreseen by the project" (Comarov P., interview, July 17, 2008).

Fuel switch projects are risky due to the unstable market prices for fuel. A too high and unexpected rise in the natural gas price can make the project unprofitable even with the revenue from the CERs. The prices for the public organizations should be and most probably are adjusted, thus the revenue part of the budget will be adjusted to the costs, however, most likely not to the same extent, thus the budget might require a cut in the energy consumption. If so, it will increase the revenue from the CERs, but decrease the level of the comfort for the project beneficiaries, distorting the sustainability component of the project. More to that, if the prices are adjusted and the revenue increased, the financial calculations for the project should be adjusted to reflect the true cost of the fuel. Otherwise, the project will remain unprofitable. This is the case when the financial calculations for the justification of the economic additionality should not be based on the cost comparison (without considering the revenues), but instead compare NPVs for the respective baseline and project scenarios. The increasing prices for the fossil fuels should trigger the demand for the end-use energy efficiency solutions and cheaper local renewable fuels (e.g. baled straw in Moldova) (Gobjila, 2007).

The same concerns the CERs prices or any other market variable. When the profitability and therefore implementation of the project depends on the market price of the CERs, it is a very unstable criterion. However, this is the main prerequisite for participation in the CDM. Lower prices may negatively affect the project's economic performance, thus not fulfilling their role of creating the marginal revenue. The contracts with the fixed price for the CERs do not allow the project owners to benefit from the current increase in the CERs market price. On the other hand, the CDM projects, which have not yet started generating CERs, pose a risk for the CER buyers; therefore lower and fixed prices of the contracts contribute to the risk minimization for the CER purchasers, while creating an immediate benefit for the project owners.

Transaction costs raise a big discussion among the CDM experts. It is not possible to avoid the transaction costs, but it is possible to reduce them. Small-scale projects are a very vulnerable group of the CDM projects, due to the high value of the transaction costs per ton of CO_2 emission reductions. Already they are benefitting from the simplified methodologies, which may cost less, but this still does not address many of the important issues, as mentioned above. Different techniques, such as bundling and less often verification are used to reduce the transaction costs. However, all of them have positive as well as negative effects. For example, bundling reduces the fixed costs, but complicates the monitoring procedure and the data collection. Simplification and standardization of the baseline and monitoring methodologies as well as additionality requirements could significantly reduce the pre-implementation transaction costs for the information, consulting, design and post-implementation monitoring. On the other hand, simplification should not undermine the environmental integrity of the CDM, creating a loose framework for the project eligibility. There is another barrier to the improved reliability and accurate verification of the project results: lack of the trained staff in the CDM organizational structure. This barrier limits the CDM capability to approve more and diverse projects for implementation and prolongs the timing for the registration, while more various projects are needed for implementation not only for their sustainability potential, but also for their ability to contribute to closing the knowledge gaps in the CDM operation.

The cost risks should be minimized by a careful allocation of the cost obligations among the project participants and the CERs purchasers. The risk of the cost overrun and underperformance should be minimized by the stakeholder commitment and a close cooperation with the National CDM Authorities and financing parties on the action plan, budget execution and the overall project management, establishment of the transparent performance criteria and a careful monitoring and verification of the project progress. It should be noted that the development of a business model for the CDM incurs the need for an extensive capacity building for the project participants not only on the Kyoto Protocol and operation of the CDM, but also on the project and risk management. Much knowledge is needed for the investigation of the legal and contractual options for the risk allocation, development of new and more efficient mechanisms of securing the required level of the project performance.

After the Kyoto Protocol entered into force there is less risk for the investors to remain without any reimbursement for the carbon credit. However, the CDM is a very young mechanism and there is still need for more experience and knowledge about the risks and uncertainties in the CDM projects. The more projects enter the pipeline, the more lessons are learned about how to handle these risks. The present research aimed at contributing to closing a knowledge gap on the uncertainties in the CDM financing arising from a number of market and policy conditions in a specific sector of energy efficiency in public buildings. This sector is extremely underrepresented in the CDM pipeline, although incurs significant economic and social benefits and a large potential for contributing to the Sustainable Development. The existing projects in energy efficiency in buildings need to be further studied on their real performance and the causes for their success or failure. A significant barrier in the CDM energy efficiency – transaction costs – is very specific for each individual project; therefore it is important that each case is studied individually on the composition and scale of transaction costs, their origin and possibilities for their reduction. Due to the fact that the main contributor to the transaction costs is the CDM project cycle itself, the research on the new and optimization of the existing methodologies can substantially foster positive transformations in the CDM modalities and procedures and contribute to promotion of the CDM in the sectors strategically important for the achievement of the Sustainable Development goals.

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3. Braga, Dumitru, Carbon Finance Unit Moldova, technical advisor, interview on July 14, 2008
4. Drucioc, Stela, Carbon Finance Unit Moldova, director, interview on July 14, 2008
5. Bordeianu, Cornel, Ministry of Environment of Moldova, CAPMU project manager, interview on July 14, 2008
6. Comarov, Petr, WB Energy II Project Moldova, MEPIUheating component consultant, interview on July 17, 2008

Appendix A

Map of the Republic Moldova

Figure I. Map of the Republic of Moldova

Source: UNFCCC, 2008c

Appendix B

Project activities of Moldova CDM project and their main technical parameters

Location	Project Activity	Public facilities	Heated area, m^2	Heat demand kW	PA forseen installed capacity, kW	Fuel switching*	Type of existing heating source
Cantemir	PA1	Romanian school	5355	341	723	1,4 to 3	Stove
		Kindergarten nr.3	3430	262			
	PA2	Russian school	2790	172	298	1,4 to 3	Stove
		Kindergarten nr.1	1250	76			
Făleşti	PA3	Gimnazium No.5	3700	180	224	1,4 to 3	Boiler U5
	PA4	Kindergarten nr.5	1330	98	294	1,4 to 3	Stove
		Library	1440	77			
		Center of arts	925	70			
	PA5	Kindergarten nr.10	4800	22	358	1,4 to 3	Stove
	PA6	District hospital+CFD	12000	640	1100	1 to 3	Boiler U5
	PA7	Orphanage	10000	650	1044	1,4 to 3	Boiler U5
Floreşti	PA8	Cultural center	1554	20	140	E/e to 3	El. Heating
		City Museum	720	22			
	PA9	Center of arts	1862	100	190	E/e to 3	El. Heating
Străşeni	PA10	Musical school	2389	120	280	E/e to 3	El. Heating
	PA11	School nr.1	15040	300	570	1,4 to 3	Boiler U6
	PA12	Kindergarten nr.1	2000	50	50	1,4 to 3	Boiler U5
	PA13	District hospital	6768	800	820	1,4 to 3	Boiler U5
Hânceşti	PA14	District hospital	22164	1700	2250	2 to 3	Boiler KVGM
	PA15	Orphanage	7696	460	650	1 to 3	Boiler U5
	PA16	Construction College	16800	217	500	1 to 3	Boiler U7
Ialoveni	PA17	District hospital	9470	430	1070	E/e to 3	El. Heating

Nisporeni	PA18	District hospital	18946	800	1350	2 to 3	Boiler KVGM
Leova	PA19	Lev Tolstoi lyceum	9170	140	1000	1 to 3	Boiler U5
	PA20	District hospital	12000	660	1200	1 to 3	Boiler F09/1
Cupcini	PA21	Orphanage	7475	500	1160	1 to 3	Boiler U5
Mărculeşti	PA22	Professional school	14600	620	1420	1 to 3	Boiler U5
Drochia	PA23	Professional school	1460	380	600	E/e to 3	El. heating
Ungheni	PA24	Kindergarten nr.3+Residential	3207	366	4000	2 to 3	Boiler KVGM
	PA25	Kindergarten nr.4+Residential	2312	891	4000	E/e to 3	El. heating
	PA26	Medical college+Residential	4197	329	2000	E/e to 3	El. heating
	PA27	Kindergarten nr.2+School	3207	256	1000	2 to 3	Boiler KVGM

** Type of fuels: 1 – coal; 2 – heavy fuel oil; 3 – natural gas; 4 – wood, e/e – electricity.*

Note: highlighted grey are the dropped out project participants

Source: CFU and MEPIU, 2005

Appendix C

Initial assumptions

Indicator	Explanation	Value	Units
y	Reference year for discounting	2004	
	Project cost	2 500 000	USD
aL	Annual loan repayment	406863	USD
P_g	Natural gas price	80	USD/1000 m^3
	Natural gas price annual growth rate	6	%
r	Discount rate	10	%
OM	O&M costs rate (as function of project cost)	6	%
P_s	Baseline energy service price for the reference year	26	USD/MWh
	Baseline energy service price annual growth rate	1.5	%
pCER	GHG emission reduction price	4.6	USD/t
k_{em}	Low heat value, Coal	5.556	kWh/kg
k_{em}	Low heat value, Heavy fuel oil	10.746	kWh/kg
k_{em}	Low heat value, Gas	9.306	kWh/m^3
k_{em}	Low heat value, Wood	2.941	kWh/m^3
	Crediting period	10	Years
k_e	Emission factor, Coal	0.342	t/MWh
k_e	Emission factor, Heavy fuel oil	0.278	t/MWh
k_e	Emission factor, Gas	0.199	t/MWh
k_e	Emission factor, Wood	0.305	t/MWh
η_{b2}	New Gas Boiler Efficiency	92	%
η_{b1}	Efficiency of the existent KVG boilers on natural gas	91	%
η_{b1}	Electricity production efficiency at local power plants	30	%
η_{b1}	Existent Coal fired Boiler Efficiency (U5 - U7)	60	%
η_{b1}	Existent Boiler Efficiency (heat stove)	40	%
η_{b1}	Existent Heavy fuel oil fired Boiler Efficiency	87	%
η_{n2}	External network losses rate for new heating systems	98	%
η_{n1}	Overall existing external network efficiency	90	%
η_{n1}	Overall electrical network efficiency	80	%
	Annual consumption growth rate (pessimistic value)	5	%
	Electrical heating length	1800	Hours
S	Length of standard heating season	4350	Hours

Source: CFU and MEPIU, 2005

Appendix D

Calculations of the project indicators

a) General

Indicator	Explanation	Formula	Units
D	Heat demand before project	Primary data	MW
Wi	Project installed capacity	Primary data	MW
V_b	Baseline quantity of fuel by type	Primary data	tones of coal, tones of heavy fuel oil, thousand m3 of natural gas, m^3 of wood
η_{s1}	Efficiency of the old system	$\eta_{s1} = \eta_{b1} * \eta_{n1}$	%
η_{s2}	Efficiency of the new system	$\eta_{s2} = \eta_{b2} * \eta_{n2}$	%
Q	Baseline final useful energy consumption = project final useful energy consumption	$Q = V_b * k_{em} * \eta_{s1}$	MWh
V_p	Project quantity of natural gas	$V_p = Q / \eta_{s2} / k_{em}$	thousand m3
E_b	Baseline emissions	$E_b = V_b * k_{em} * k_e$	tones CO2 e
E_p	project emissions	$E_p = V_p * k_{em} * k_e$	tones CO2 e
ER	project emission reductions	$ER = E_b - E_p$	tones CO2 e

Source: UNFCCC, 2008c; UNFCCC, 2006

b) Suppressed demand

Indicator	Explanation	Formula	Units
H_{n2}	embodied heat needed to achieve full length heating season and normal temperature after project	$H_{n2} = Wi * S$ (constant)	MWh
H_{n1}	embodied heat needed to achieve full length heating season and normal temperature before project	$H_{n1} = H_{n2} * \eta_{s2} * H_b /$ Qb (constant)	MWh
ES_n	Energy savings if no suppressed demand	$ES_n = H_{n1} – H_{n2}$	MWh
SD	Suppressed demand	$SD = H_{n1} – V_b * k_{em}$	MWh

Source: UNFCCC, 2008c; UNFCCC, 2006

c) Standard levels of heat consumption (for consumption growth scenarios)

Indicator	Explanation	Formula	Units
Q_s	Energy consumption needed to achieve full length of heating season	Qs = D * S (constant)	MWh
Q_n	Energy consumption needed to achieve full length heating season and normal temperature	$Qn = H_{n2} * \eta_{s2}$	MWh

Source: UNFCCC, 2008c; UNFCCC, 2006

d) Budgetary constraints

Indicator	Explanation	Formula	Units
H_b	Embodied heat for baseline energy consumption if no project	$H_b = V_b * k_{em}$	MWh
H_p	Embodied heat for baseline energy consumption if project implemented	$H_p = Q / \eta_{s2}$	MWh
ES	Energy savings	$ES = H_b - H_p$	MWh
H_1	Embodied heat consumption if no budget reduction	$H_1 = H_p * EC_b / EC_p$	MWh
E_1	Emissions if no budget reduction	$E_1 = H_1 * k_e$	t CO2e

Source: UNFCCC, 2008c; UNFCCC, 2006

e) Cost-revenue analysis

Indicator	Explanation	Formula	Units
EC_b	Spending on energy service before project	$EC_b = P_s * Q$	USD
EC_p	Spending on energy service after project	$EC_p = V_p * P_g + OM$	USD
dEC_b	Discounted baseline energy cost	$\sum EC_b * (1+r)^{-y}$	USD
dEC_p	Discounted project energy cost	$\sum (EC_p+aL)* (1+r)^{-y}$	USD
NPV1	NPV without CERs	$NPV1 = dEC_b - dEC_p$	USD
NPV2	NPV with CERs	$NPV2 = NPV1 + \sum ER * pCER (1+r)^{-y}$	USD

Source: UNFCCC, 2008c; UNFCCC, 2006