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Investigating the feasibility of using CDM for Solar Home Systems in Ugandan Healthcare

– Exploring the potential for the ICT4MPOWER project and beyond

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Abstract

Investigating the feasibility of using CDM for Solar Home Systems in Ugandan Healthcare – Exploring the potential for the ICT4MPOWER project and beyond

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The Kyoto related mechanism – clean development mechanism (CDM) – can be used to generate certified emission reductions (CERs) for climate mitigating projects in developing countries. These credits provide an opportunity for additional project financing. This thesis has investigated the feasibility of using the CDM for off-grid solar home systems in order to electrify health centers in Uganda. The investigated scope includes two scenarios; one related to a particular project, ICT4MPOWER, and another one related to a national scenario of health center electrification. Two dimensions of feasibility have been targeted; legal prerequisites – various regulations that govern CDM projects – and value creating potential. The latter dimension has primarily focused on whether sufficient CDM-specific profit can be generated, but also looked at broader perspectives of value creation.

Calculated break-even scenarios show that the expected scope of the ICT4MPOWER project is far too small to benefit from CDM. A national scenario improves the chances of generating a sufficient profit but would most likely still be too small. A project with broader national coverage would likely need to be arranged as a CDM program of activites (PoA). Such an arrangement has organizational benefits but does further worsen the financial outlook. Apart from the unfortunate value creating prospects, there are also obstacles related to legal prerequisites. To establish a baseline – the business as usual scenario which reflect the emission reduction potential of a project – may be difficult and somewhat ad-hoc. To demonstrate additionality – that the project would not have been carried out anyway – is another potential obstacle which applies to the PoA scenario. All in all, there are clear doubts that CDM would be a feasible solution for the investigated scenarios.

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Sammanfattning

Clean Development Mechanism (CDM) är en så kallad projektmekanism som hör till Kyotoprotokollet. Energirelaterade projekt i utvecklingsländer som leder till minskade utsläpp av växthusgaser har möjlighet att registreras som CDM projekt och därefter generera certifierade utsläppsminskningar (CER). För att detta ska kunna ske måste en mängd krav uppfyllas. Bland annat måste projektet anses bidra till en hållbar utveckling i värdlandet. De certifierade utsläppsminskningarna, vardera motsvarande ett ton koldioxidekvivalenter, kan säljas till en aktör i ett i-land med krav på sig att minska sina utsläpp. Denna part kan då tillgodoräkna sig de köpa utsläppsminskningarna. För att garantera att ett projekt uppfyller alla de krav som ställs måste dokumentation ske och verifieras innan det kan registreras som ett CDM projekt. Projektverksamheten måste sedan även kontrolleras. Dessa procedurer genererar en mängd CDM-specifika kostnader – transaktionskostnader. Antalet CER som kan genereras och deras uppskattade marknadsvärde, sett i relation till tillhörande transaktionskostnaderna, styr därmed möjligheten att tilläggsfinansiera ett projekt.

Detta examensarbete har undersökt möjligheterna att använda CDM för solcellssystem för att elektrifiera hälsocenter i Uganda. Arbetet initierades av Karolinska Universitetssjukhuset och en projektgrupp som heter ICT4MPOWER. Projektet med samma namn syftar till att ta fram ett elektroniskt baserad hälsosystem för en av Ugandas södra regioner och på så sätt förbättra vårdmöjligheterna i denna region. Projektet bedrivs i samarbete med hälsovårdsministeriet i Uganda. Förhoppningen är att detta koncept sedan ska kunna utvidgas till fler regioner i landet. Tillgång till elektricitet är en förutsättning för projektverksamheten och installering av solcellssystem har tidigare identifierats som en önskvärd lösning för att fylla det elektrifieringsbehov som saknas i dagsläget. Då tillgången till finansiella medel utgjorde ett hinder och omständigheterna för projektet på flera sätt sammanföll med förutsättningarna för CDM, fanns indikationer på att denna projektmekanism kunde vara lämplig att använda sig av. Utöver att undersöka möjligheten att använda CDM för projektomfånget för ICT4MPOWER har även ett vidare nationellt scenario för elektrifiering av hälsocenter undersökts. De aspekter som varit i fokus för studien är legala och regulativa förutsättning samt värdeskapande. Den senare aspekten har huvudsakligen, men inte uteslutande, undersökt möjligheten att generera CDM-specifik vinst. Även övergripande organisatoriska aspekter av ett projektgenomförande har undersökts. Detta för att kunna relatera slutsatserna till praktisk tillämpbarhet.

Vad som visats är att ett projektomfång, antalet installerade Watt, behöver vara betydligt större än det som planerats för ICT4MPOWER projektet. Även utifrån ett nationellt perspektiv är det högst tveksamt om det är realistiskt att det skulle finnas en investeringspotential för solcellssystem för hälsocenter som är tillräckligt stor för att ett CDM projekt skulle generera vinst och alltså möjliggöra en tilläggsfinansiering. Detta är de huvudsakliga anledningarna till varför slutsatsen dragits att CDM inte har någon värdeskapande potential. Också utifrån ett legalt perspektiv finns vissa

tveksamheter. De utsläppsminskningar, blivande CER, som kan kalkyleras för ett projekt bygger på vilket alternativt scenario, en så kallad ”baseline”, som hänvisas till, samt de utsläpp som hör ihop med detta scenario. Dieselgeneratorer är det alternativa scenario som antagits vara potentiellt relevant för tillämpningen av solcellssystem i denna studie. Att etablera en ”baseline” för dieselgeneratorer är dock förenad med vissa tveksamheter, då installationer av solcellssystem, snarare än installering av dieselsystem, genomförs av statliga program i dagsläget.

Sammantaget har slutsatsen dragits att CDM inte är lämpligt att använda för ICT4MPOWER projektet. Slutsatsen är också att CDM inte heller är relevant ur ett nationellt perspektiv om inte förutsättningarna visar sig vara mer fördelaktiga än vad som antagits i detta arbete.

Acknowledgements

The most part of the research process has been spent at Karolinska University Hospital, at the Biomedical engineering department. I am much grateful to Rustam Nabiev and the rest of the ICT4MPOWER team for welcoming me and giving me the opportunity to learn and take part of various project activities. I would also like to direct a particular thanks to Max Tran, for helpful discussions and suggestions regarding sources. If it were not for these people, this thesis would not have been commenced.

I am also very grateful to the people whom I have interviewed, for sharing their time and insights with me. Additional thanks to Ulrika Raab for providing feedback on parts of the draft version of the thesis. Lastly, I would like to thank my supervisor, Enrico Baraldi, who has given me many thoughtful suggestions on how to structure and outline the thesis.

You have all been a source of inspiration and made this work more enjoyable. Thanks.

Stockholm, February 2011
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List of Acronyms and abbreviations

AMS	Approved Methodology for small-scale CDM project activities
CCX	Chicago Climate Exchange
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CMP	Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CPA	CDM Program Activity
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board of the CDM
ER	Emission Reductions
ERT	Energy for Rural Transformation
ERPA	Emission Reduction Purchase Agreement
EU ETS	European Union Emissions Trading Scheme
HSSP	Health Sector Strategic Plan
ICT	Information and Communication Technology
IDA	International Development Agency
IBRD	International Bank for Reconstruction and Development
NEMA	National Environmental Management Authority (of Uganda)
NGO	Non-governmental organization
OTC	Over-the-Counter
LDC	Least Developed Country
PoA	CDM Program of Activities
PDA	Project Development Agreement
PDD	Project Design Document
REA	Rural Electrification Agency
Sida	Swedish International Development Agency
SCC	Small scale CDM project
SPIDER	Swedish Program of ICT for Developing Countries
SHS	Solar Home Systems
tCO_2	One metric tone of carbon dioxide equivalents
UNEP	United Nations Environmental Program
VER	Voluntary (or verified) Emission Reduction
W	Watt

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1 Introduction

Combating climate change and promoting development in developing countries are two of the major global priorities today. The need to take measures to combat climate change is an issue which seems to gain attention every year since the adoption of the global climate change convention; United Nations Framework Convention on Climate Change (UNFCCC), in 1992. Global priorities for development were outlined in the Millennium Development Goals which were adopted in 2000. Out of the eight goals in total, three relate directly to improvement of health conditions and one relate directly to environmental sustainability. With less than 5 years left to the deadline in 2015 there are still many challenges left in order to meet these goals. (United Nations, 2010) Clean Development Mechanism (CDM) can be seen as a strategy for how to link global concerns for development and environment together by usage of market mechanisms and legal rigidity.

CDM form part of the Kyoto Protocol, which is the only document related to the UNFCCC which provides a structure for legally binding emission reductions quotas of greenhouse gases. CDM is a project based mechanism which is designed to help developing countries in achieving a sustainable development, while simultaneously aiding developed countries to comply with agreements made under the Kyoto Protocol. The mechanism is designed so that eligible climate change mitigating projects taking place in developing countries are generating credits which can be bought by developed countries. It is by the generation of these credits, later turned into certified emission reductions (CERs), that there is a business incentive for arranging a project as a CDM activity.

This thesis was initiated by Karolinska University Hospital for the purpose to investigate CDM in relation to the ongoing project; ICT4MPOWER, which is a collaboration between Karolinska University Hospital and Ministry of Health in Uganda, among other parties. The goal of the ICT4MPOWER project is to improve the health care system within the Isingiro district in Uganda. This is to be done by the means of information and communication technology (ICT) which can help empower health workers and improve the information flow within the system. Since the ICT equipment need energy to function, and the major part of the Isingiro district lack a sufficient energy solution, this must also be implemented in order to achieve the overall goals of the project. Solar Home Systems (SHS) is the energy solution which has earlier been identified by the project as a desired solution.

When commencing the thesis, the challenges for the energy component of the project were whether current financial arrangements would cover investment costs for the energy requirements for the full scope of the project. There were furthermore doubts about whether financial and organizational resources for ongoing maintenance could be located. Uganda being a developing country, SHS being a renewable energy solution and the project design clearly aiming to contribute to a sustainable development are three conditions which indicate that CDM might be suitable. These conditions, together with the challenges that faced the ICT4MPOWER project and the revenue potentials of CDM, have been the initial reasons for investigating the feasibility of using CDM in relation to this project.

ICT4MPOWER is designed as a pilot project. One of the objectives of the project is that it may be able to function as a blue-print and proof of concept for a scalable national solution. To explore the potential of scaling up CDM has therefore been a natural part of the investigation. The feasibility of using CDM for SHS on a broader scale within Ugandan healthcare will be explored in relation to the ICT4MPOWER project as well as beyond; i.e. independently from this project.

1.1 Background on CDM

1.1.1 The legal framework of the mechanism

Introduction: CDM is one out of three[1] so called flexible mechanisms which have been established under the Kyoto Protocol in 1997 (United Nations, 1998). The Protocol didn't become international law until February 2005. (Henson, 2006) The first CDM project was registered a few months before this date, in November 2004. (UNFCCC Secretariat, 2010)

Overall purpose: The purpose of the mechanism is to enable cost effective reductions of greenhouse gases, meanwhile contributing to a sustainable development in a developing country. The purpose is outlined in article 12 in the Kyoto Protocol with the following words;

> "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation [...]"(Article 12, paragraph 2)

Division on countries and the notion of least developed countries: The division between developed and developing countries is formalized in the UNFCCC with reference to annexes, as shown in the above quotation. Developed countries are referred to as Annex I countries and remaining countries, such as Uganda, are called non-Annex I countries.[2] Furthermore, there are Annex II countries, a subgroup of Annex I countries with special obligations to support non-Annex I countries. There is also the notion of least developed countries (LDCs), which Uganda form part of. LDCs is a sub-group of non-Annex I countries which are given special attention in the climate change work. (United Nations, 2002)

The overall legal and financial structure: A developed country (Annex I) with an obligation to reduce emissions under the Kyoto Protocol can achieve its commitments by efforts in the own country as well as by using the flexible mechanisms. (United Nations, 2002) Participation in the CDM project involves a developed country and a developing country, which both need to be parties to the Kyoto Protocol and fulfill requirements outlined in Decision 3/CMP.1, section f.

[1] The other mechanisms are the Joint Implementation (JI) and emission trading, the carbon market.
[2] Non-annex I countries do still need to have ratified the Convention.

Almost all countries have signed and ratified the Kyoto Protocol, among the ones that have not done this are the United States. (Henson, Robert, 2006)

Emission reduction quotas for developed countries have so far been agreed for a first commitment period, 2008-2012. Targets post-2012 are still to be agreed upon (see section 5.3). After a CDM project activity has been verified, CERs – certified emission reductions – are issued (which goes on continuously during the lifetime of a project). One CER corresponds to one metric tone of CO_2 equivalents (tCO_2), which is the unit that can be traded on the carbon market. (Decision 3/CMP.1, Annex, paragraph 1(b)) CERs are sold to various actors on the carbon market, e.g. companies located in Annex I countries, or the governments of these countries. (UNEP Risoe CDM/JI Pipeline Analysis and Database December 1st 2010, 2010)

1.1.2 CDM Project Requirements

In order to be accepted as a CDM project there are several requirements which need to be fulfilled. Two main requirements related to the environmental integrity of projects are the following ones (United Nations, 1998);

(1) It needs to provide "real, measurable, and long-term benefits related to the mitigation of climate change" (article 12, paragraph 5 (b)), by usage of an *approved baseline and monitoring methodology*.

(2) It needs to result in "reductions in emissions that are *additional* to any that would occur in the absence of the certified project activity." (article 12, paragraph 5 (c)) (italicizing added)

The notation of a *baseline* is similar to business-as-usual. It refers to a reference point, and is used to compare the amount of emissions associated with the CDM project to those that would otherwise have occurred, the so called *baseline emissions*. What a *monitoring methodology* means is pretty straight forward; it is a methodology for how CDM activities can be monitored in order to prove how many emission reductions (ER) that are achieved. As mentioned in (1), projects need to make use of an "approved baseline and monitoring methodology". These include different standards related to the establishment of a baseline, monitoring of project activities and demonstration of additionality.

1.1.3 The CDM Project Cycle

A simplified view of the CDM project cycle can, in conformity with a conventional project cycle, be divided into three major phases (source: own compilation developed from UNEP Risoe Center and EcoSecurities, 2007, p.52; CDM project cycle, n.d, UNFCCC);

The components of each of these three phases are listed below and, when possible, expected timelines have been indicated.

The first phase includes;
- Project feasibility study (practical but not legal necessity)
- The development of a Project Design Document (PDD)
- Host Country Approval
- Project validation
- Project registration

The second phase includes;
- Installation and set-up of energy solution and monitoring method

The third phase includes;
- Operation, maintenance and monitoring
- Verification
- Issuance of CERs

*

Period activity

* Iterative process of verification of operation and issuance of CERs which goes on during the crediting period. The crediting period can be either 1) A maximum of 7 years which can be renewed twice OR 2) A maximum of 10 years which cannot be renewed. (Decision 4/CMP.1, Annex II, paragraph 29)

The project cycle may not always be smoothly linear as described in the above scheme. What is always the case though is that a project cannot be registered before the prior steps in the planning phase have been conducted. Neither can CERs be issued before the project activity has started and been verified.

Each of the steps in the CDM project cycle involves some costs. Costs that are specific to CDM projects, e.g. cost for validation and verification, are referred to as *transaction costs*. (UNDP, 2006, p.55)

The three central regulatory bodies involved in the CDM project cycle are the following ones;
CDM Executive Board (EB): The EB supervises CDM activities. Its responsibilities include, among other things, the following tasks; to review validation reports and project design documents and to register projects, to approve new baseline and monitoring methodologies and issuance of CERs. (CDM Executive Board, no date (n.d.))

Designated National Authority (DNA): In a Non-Annex 1 country it is the authority which grants host country approval for the project. The Ministry of Water and Environment is the Ugandan DNA. In an Annex 1 country it is the entity that approves any Annex 1 project participant, which in Sweden is the Swedish Energy Agency. (UNEP Risoe Center and EcoSecurities, 2007, p.53; Designated National Authorities, n.d.)

Designated Operational Entity (DOE): A DOE is responsible for validation and verification of the project and functions as an independent auditor. All DOEs need to be approved by the EB. (Designated Operational Entities, n.d.)

Another notation of importance is the *CDM pipeline*. The CDM pipeline is often used to refer to all projects that are at the validation stage, waiting to be registered or that are successfully registered. This is how the term will be used throughout this thesis.

1.1.4 Simplified model

Figure 1 presents the main idea behind CDM.

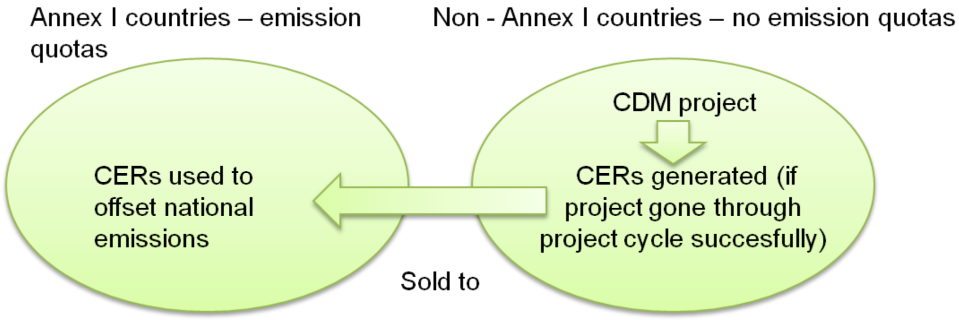

Figure 1: Simplified model for how CDM functions. (Source: own compilation)

1.2 Project design documents and previous research

Every project that wishes to be conducted as a CDM project needs to go through a project cycle which involves predefined requirements of communication and documentation, as outlined in above section (1.3.3). The creation of a project design document (PDD) is one of the major components. The PDD has to provide evidence that the project is eligible for CDM. (UNEP Risoe Center and EcoSecurities, 2007) Previous PDD reports do in this way comprise relevant "previous research" although adopted in practical rather than academic fora. These reports are stating examples of how CDM projects can be arranged practically, as well as of *how* the legal framework has been interpreted. Findings from PDDs will not be brought up at this point but will be discussed in later chapters. This section will instead briefly discuss some of the academic reports which have been written on the subject.

The usage of the Swedish national library search for "clean development mechanism" yields nineteen hits. Out of these ones I found one which was related to SHS in eastern Africa, Tanzania more specifically (Samuelsson G. et.al. 2003). This paper finds it is more cost-effective to remove one tCO_2 in Sweden compared to Tanzania, and therefore concludes that it is not yet economically profitable to use CDM as a tool for removing the financial barrier to SHS in this case. The study is not looking into transaction costs of CDM, revenues perspectives from CERs or any financial and organizational models of CDM. It is furthermore limited to the specific case where the solar technology is bought in Tanzania.

Apart from the above mentioned search engine, I have searched articles via various databases, especially Science Direct (Elsevier Journals), for key words including "solar home systems" plus "CDM", in combination with other key words, and reviewed titles and abstracts plus some of more related articles. Reviewed articles include Chaurey et.al. (2009) which discusses the cost-reduction potential for SHS due to carbon finance in India. Chaurey et al. enlighten different factors that affect the financial attractiveness of a CDM project, e.g. the influence of transaction costs for a project. References are made to a study on rural electrification CDM projects from 2005, where it was concluded that transaction costs were reaching up to about 80 percentage of the CER price. For scenarios similar to this it was assumed that projects need to generate more than 4000CERs/year in order to be attractive for carbon finance.

Another source which includes similar approximations can be mentioned at this point; UNDP (2006, pp. 70) estimates that projects are financially unattractive if they generate less than 5000 CER per year. At that size it is considered likely that the projects absorb most of their transaction cost unless CER prices exceed US$ 15-20. Solar PV projects are expected to have to be larger than 500kW to recover their transaction costs unless CER price is above US$25.

1.3 Purpose

The overall purpose of the thesis is to investigate and analyze the feasibility of using CDM for Solar Home Systems (SHS) in Ugandan healthcare settings. Feasibility will particularly be related to legal prerequisites and value creation, as outlined in section 1.4.1.

This investigation will look at feasibility in relation to the following two scenarios;

(1) The energy component of the ICT4MPOWER project or any constellation which would include this project

(2) Electrification of health centers in Uganda from a national perspective

1.4 Scope and delimitations of the investigation

1.4.1 Legal prerequisites and value creation

For all activities, business as well as not-for-profit, there are institutional frameworks such as laws and regulation that need to be recognized. This dimension is however a much greater issue for CDM projects than for projects in general. The very introduction of the mechanism is part of a legal structure (the Kyoto Protocol). The strict regulatory framework which governs CDM activities is designed to ensure that the mechanism is used in a way which keeps the environmental integrity of the climate convention. (Marrakesh Accords and Declaration, 2002, Draft decision -/CMP.1 (Mechanisms), preamble) To explore the legal dimension of CDM will therefore be a main component of this thesis work.

Being consistent with the legally framework is not the only aspect which would make the usage of CDM feasible. It also needs to be practically possible as well as beneficial. If no value was created there would not be any reason to make use of the mechanism. To look at potential value creation from using CDM is therefore another keystone of the investigation. That CDM need to generate a revenue stream (greater than its transactions costs) will be considered as the most basic requirement from an economical perspective. To outline costs and revenues associated with CDM is therefore an important part of the scope. The value creating dimension will also be enlightened by bringing in a stakeholder perspective. I will look at how stakeholder roles and organizational and financial arrangements of a project may affect the prerequisites for creating value.

1.4.2 Technology and national context

The feasibility of using SHS (regardless of whether it is implemented as a CDM project or not) is not part of the main focus. At the ICT4MPOWER level it has already been explored by a parallel thesis project, started in April by Max Tran (2010). Tran has focused on energy needs and specifications for health units and concludes that stand-alone (off-grid) SHS are the most feasible energy solution for the ICT4MPOWER project. Many of the reasons for this conclusion would be applicable also on a national scale. Off-grid SHS is therefore the technology which I have primarily focused on when investigation prerequisites for using CDM. Energy services which will be considered in relation to the ICT4MPOWER project includes, but is not limited to, powering of ICT equipment. In the national scenario it may or may not include powering of ICT equipment. Some additional information about the feasibility of SHS is however crucial to gather in order to analyze feasibility in relation to CDM. I have mapped current conditions, national policies and ongoing activities in the energy and health area. To estimate the potential scope of a project from a national perspective is one of the concrete desired outputs of this investigation.

The suggestion put forth by Tran is that the ICT4MPOWER should make use of technology from the world market to ensure the best sustainability of the energy solution (Tran, Max, 2010, p.42). Contribution to technology transfer is considered as one of the advantages of CDM. (Schneider et al., 2008) Considerations outlined in relation to technology transfer have therefore been included in the scope.

1.4.3 Research questions

Below are four of the more crucial questions which have been targeted in order to fulfill the overall purpose. These are all related to the ICT4MPOWER project as well as to a general national scenario.

- *What are crucial factors which affect the legal applicability for CDM?*
- *What are expected break-even scenarios for different types of CDM projects?*
- *What are crucial factors which affect the value creating potential for CDM?*
- *What scenarios would make the usage of CDM legally applicable and value creating?*

1.5 Methodology

1.5.1 Type of sources

The initial objective of the research was to provide answers to a real-world problem, if it is possible and desirable to make use of CDM for the purposes of the ICT4MPOWER project. The research has been guided by an aim to get a practical perspective of how CDM is used and organized. It has also been a central aim to gain a solid understanding of the legal framework that regulates project activities. The research scope has been formed through an iterative process, where updates have sought to target practical applicability of CDM based on results along the research process. The current scope has included a review of the following components;

(1) The empirical setting in Uganda; the scope and aims of the ICT4MPOWER project and relevant aspects of the national context (mentioned in section 1.4.2)

(2) CDM framework; projects types and legal requirements

(3) CDM pipeline and previous projects

(4) Theoretical views related to value-creation

(5) The CER market, organizational and financial structures and revenue potentials

(6) Requirements, transaction costs and challenges related to the CDM project cycle

Apart from purely theoretical aspects, I have tried to access as recent information as possible. Most conclusions, e.g. related to legal considerations, cost and revenue prospects etc. would be of little value if old sources were used since matters on CDM are constantly changing.

A starting point regarding practical information have been that it is likely practitioners; the people who have been working with CDM projects in one way or another, that have most insights about the limitations and possibilities of CDM. Information of a practical kind have been acquired through *personal consultations*, *guidelines* developed from CDM capacity development experiences etc., *seminars* on CDM, CDM *pipeline statistics* and *PDD reports*. These sources are providing empirical as well as theoretical insights, particularly related to points (2), (3), (5) and (6), outlined above.

Matters related to personal consultations are handled by the following section (1.5.2). Most guidelines on CDM are developed from the capacity development program organized by UNEP Risoe Center, also described in 1.5.2. Concerning information gathering from seminars on CDM, I have personally attended one seminar; “Enhancing the engagement in the carbon market in Africa”, held in Stockholm 19 November and hosted by the Swedish Energy Agency. Information obtained from there will be cited as a primary source and noted as “CDM seminar”. I have also reviewed presentation material available online from the following two seminars; “Enhancing the potential for clean development mechanism activities in Africa”. A regional conference on legal and fiscal aspects on CDM held in Addis Addeba 7-9 September 2009. And; “Workshop on Institutional and Organizational Models for Programme of Activities – What makes a Coordinating/Managing Entity Successful?” held in Cologne 25 May 2010 and hosted by the World Bank.

Regarding the CDM pipeline I have mainly used statistics from November 2010, compiled in excel format by Joergen Fennham at the UNEP Risoe Center (UNEP Risoe CDM/JI Pipeline Analysis and Database November 1st 2010, 2010). The unfccc.int web page have been used as a complement; to find out more information about the projects and review PDDs. PDD documentation of registered projects can be found via a CDM project reference number using the CDM project search page (http://cdm.unfccc.int/Projects/projsearch.html). The PDDs which have been studied more into depth are those which make use of the same methodology as the one identified as relevant for this thesis. One Ugandan PDD has also been selected.[3] Regarding benefits of this type of information see section 1.2.

Most of the legal/regulatory information on CDM has been gathered in a direct way, by reviewing regulations by the CDM Executive Board which are available on the unfccc.int web page. To easier-access and overview the large amount of rules,

[3] How PDDs have been chosen is further outline in section 6.2.1 and 6.2.2.

another web page has been established; cdmrulebook.org organized by Baker and McKenzie[4]. This has also been an important source of information to get an orientation of the legal framework.

Information on Ugandan contexts has largely been gathered through national policy documents and from web pages of identified relevant governmental entities. Market information has largely been compiled through a review of market reports and from web pages of major players in the carbon market. Regarding the more theoretical related material which has reviewed; this has mainly included perspectives related to social entrepreneurship and technology transfer. This material has been integrated in the overall research as I have found out more about CDM, and hence not been chosen beforehand. For an explanation of the purpose of this material see Chapter 2 (introduction part).

1.5.2 Personal consultations, realized and planned for

The purpose of the consultations has been to broaden the perspective on CDM projects with regard to what the challenges and success factors are as well as to get feedback on some interpretations of the policy framework. For this purpose I have sought to interview people which can be thought of as experienced practitioners in the field, e.g. having direct experience of working with CDM projects. Of the total of four consultations, three have been of a discussion character, somewhere between semi-structured and unstructured (see e.g. Adams [ed.], 2007) and one have been based on written questions through e-mail correspondence.

The Sweden entity with main responsibility for participation in CDM (The Swedish DNA) is the Swedish Energy Agency. Three people have been consulted from there; Kenneth Möllersten, Ulrika Raab and Angela Kallhauge. They have all been directly working with CDM and have a policy perspective as well as a practical perspective on the project mechanism. The method used for identifying relevant people to interview can be referred to as the snowball method (see e.g. Adams [ed.], 2007). Raab and Kallhauge were identified through Möllersten. Via Kallhauge I was later recommended to interview another person, Deborah Cornland. Cornland has, among other things, worked as an external consultant for the Swedish Energy Agency to help develop a CDM portfolio for investment purposes. A few minor follow-up questions have also been sent via e-mail to Möllersten and Kallhauge.

I also tried to receive feedback from the UNEP Risoe Center in Denmark, a research institute which has been in charge of CD4CDM – a capacity development program for CDM. CD4CDM was launched by the United Nations Environmental Program (UNEP) and is a major program for capacity building in host countries for CDM purposes. The initiated contact (e-mail and phone call) with people (two people were consulted) from there were less successful and no interviews were fulfilled. What I learned from the feedback I got was however that this program, CD4CDM, is not

[4] Baker and McKenzie is a global law firm with large involvement in environmental and climate change issues.

currently running. Guidelines developed from these programs has been reviewed and can somewhat make up for the uncompleted interviews.

I have also sought to get a perspective from Ugandan people involved with CDM. Two people who were presented as contact persons within the CD4CDM program and localized in Uganda were identified, both working at Makerere University. One of them was consulted through e-mail but I was unfortunately unable to receive any substantial feedback. Climate Change Concern (CCC), a non-governmental organization in Uganda which provides legal advises on CDM, was also identified as a relevant actor and consulted, but were not willing to share their perspective on CDM unless they were contracted as consultants.

Information about the ICT4MPOWER project has largely been gathered through participation in meetings and discussions with project members. This includes weekly meetings with most of the Swedish project members (around eight) on general project updates and progress, three days of participation in an ICT4MPOWER developers meeting in Stockholm held in mid-August where several project members from Uganda as well as Sweden participated, and a two day long e-health seminar held mid-September co-arranged by the Karolinska University Hospital where Swedish project members participated. Internally adopted project documents have also been reviewed. The information which is included in the final thesis has been double-checked with Rustam Nabiev, thesis mentor and project manager. For this reason most project related references will refer to the date of double-checking.

1.5.3 Changing directions – changes of focus in the research process

I started out the research by focusing on whether CDM would be feasible to use for the ICT4MPOWER project. This scope has continuously been extended. After having conducted some overview analysis of CDM-specific cost and revenue prospects I found out that the scope of a CDM project would have to be much larger than the energy requirements needed for the ICT4MPOWER project. This led me to investigate the possibility of using a broad CDM scope that could include the energy component of the ICT4MPOWER project as one out of several constituting parts of a CDM project. About half way through the research process I realized that the arrangement of a CDM project would require a considerable effort of resources. The chances that such an arrangement could be made in time for the implementation plans of the focal project were few. About the same time, the scope of the project became reduced, which in turn reduced the amount of SHS that would need to be financed. These results led me to suggest that the project participants of the ICT4MPOWER project should not consider CDM. To investigate CDM more into depth and to further outline challenges and opportunities directly related to the ICT4MPOWER project was therefore no longer of special concern.

The results I had received from the first part of the research process did yet point to that CDM could still be relevant for the general context which was investigated; SHS in Ugandan healthcare. Given these results, there was still reason to move on with the investigation. The final part of the thesis has therefore investigated the feasibility for CDM projects from a more general perspective; beyond ICT4MPOWER.

An approximate timeline over the research process is outlined in figure 2, below. The dotted line indicates the time when conclusions related to ICT4MPOWER were finalized, and focus shifted completely to a national perspective.

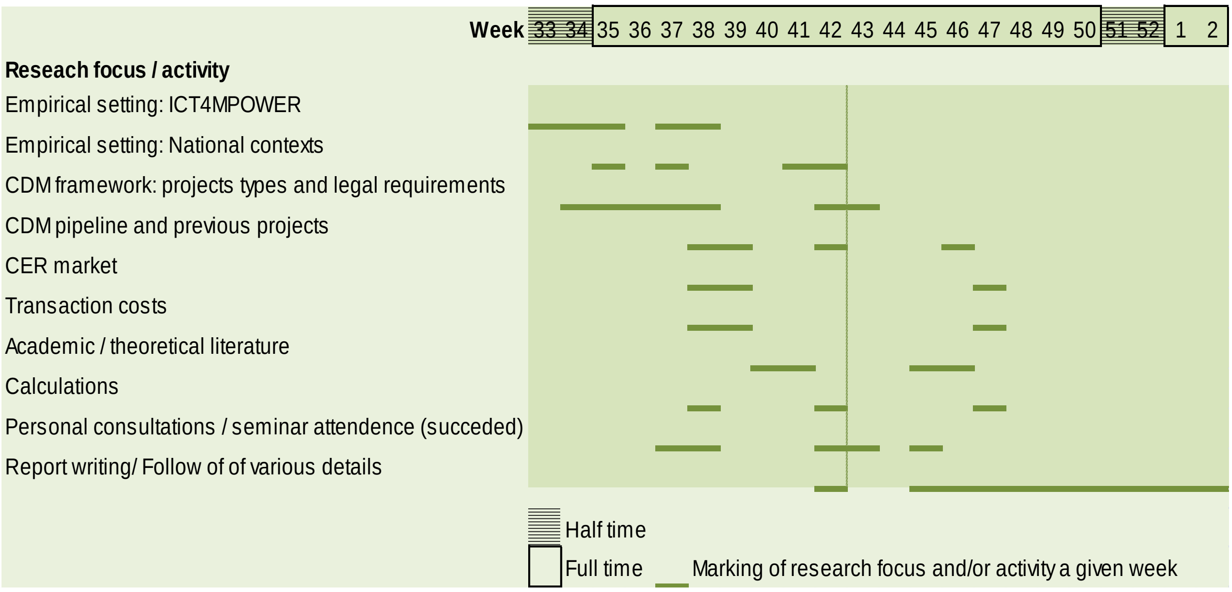

Figure 2: Timeline over research process.

1.6 Outline of the thesis

After having introduced the CDM framework, the purpose of the thesis and the methodological steps which have been used, the following part of the thesis is structured as follows; Chapter 2 will relate the activities of CDM to more general theoretical frameworks for value creation. The idea is to broaden the perspective of CDM and to get some additional input on how principles for value creation can be looked at. Chapter 3 will present the empirical setting of the investigation. An initial part does briefly outline current health and energy conditions in Uganda. This is followed up by a description of the ICT4MPOWER project; how it was developed, its' implementation plans, scope, and involved partners. Findings related to the national context, especially to ongoing activities and policies for electrification and health will also be covered. This chapter includes some concluding remarks about the approximate scope of a national electrification project, as well as the ICT4MPOWER, which to relate further findings on CDM.

Chapter 4 will outline findings related to the carbon market and give a brief about how the market is structured and how prices are set. Chapter 5 will present potential CDM project types. This chapter does also introduce the previous CDM projects which have been studied to give insights into how the mechanism has been used. The various CDM requirements which have been investigated, those outlined in 1.1.2 and additional ones, are all presented and analyzed in this chapter. The focus of the analysis in this chapter is particularly placed on legal prerequisites.

Chapter 6 will look more deeply into the development process of CDM, the stakeholder roles which are needed to go though the project cycle and potential relationships between buyers and sellers. Previous experiences from CDM capacity development programs are also presented. Chapter 7 will present findings on transaction cost and break-even scenarios which have been calculated to analyze the economical potential for CDM in the Ugandan context. Finally, Chapter 8 will provide summarized answers to the research questions, follow up on relevant findings related to the feasibility for CDM, and outline some final conclusions with regard to the primary purpose of the thesis.

2 Theoretical perspectives on value creation related to CDM

CDM can be looked at as a mechanism which formally includes several goals of value creation. The mechanism contains a set of rules for how market forces can be used to contribute to sustainability goals, as well as enabling flexibility in the steps taken towards combating climate change. To create market value as such is therefore *not* the main goal behind the establishment of the mechanism, but will most likely go hand in hand with these goals.

If CDM is a feasible solution from a value creating perspective does mainly depend on whether it is a strategic choice for *certain stakeholders* in order to fulfill a *certain purpose*. Sustainability goals related to improving health care through electrification are what will primarily be considered in relation to the ICT4MPOWER project as well as from a national perspective. The stakeholder concept is further outlined in section 2.1.4.

The purpose of this chapter is to gain a deeper theoretical understanding for different aspects of value creation. It will initially look into ways of interpreting the “business model” concept and will thereafter look into how this concept can be broadened by focusing on *value creating activities*, rather than *revenue producing activities*. Literature on value networks and social entrepreneurship, that offer ways to describe the rationale for value creating activities, will briefly be covered. The focus will thereafter be shifted towards technology transfer. As mentioned in the scope (section 1.4.2) technology transfer has been highlighted as one of the opportunities which CDM can create. Literature related to this concept provides an analytic framework for how value creating activities are enabled (through the arrangement of technology transfer). This framework has a lot in common with the more general discussions on value networks. Since the concept often is used in relation to the introduction or diffusion of environmentally friendly technologies, it is well-tailored to the context of CDM and SHS.

2.1 Value creation models; from business models to value networks and multiple values

2.1.1 Business models

The term “business model” is normally used in relation to a firm perspective, where the description of rationales for generating economic profit is the main objective of the model. Current definitions of a “business model”, found in online business dictionaries include; “description of means and methods a firm employs to earn the revenue projected in its plans” (Business model, n.d.).

Research reviews of the business model concept have concluded that it is often used quite vaguely and with shifting focuses. (Hedman and Kalling, 2002; Amit et. al 2010) Hedman and Kalling, who have explored the business model concept in relation to IT, conclude that an understanding of the business model concept is to be found in literature on business strategy and entrepreneurship. Porter's work on the five forces model, generic strategies and the value chain are some of the theoretical frameworks which are being referred to. Amit et al refers particularly to value creation as the most central common feature of the literature studied. The business model concept was however not seen as being reducible to a linear model of value creation. It was rather seen as a complex model describing intertwined elements, which is also in line with what Kalling and Hedman conclude.

The definition of a business model which Kalling and Hedman (2002, p.113) arrive at for their own purposes can be summarized as; a model which describes the relation between market factors, offerings, internal activities and organization of the firm, resources, e.g. human and physical capital, and supplier conditions. They have also included an element of longitudinal dimensions such as cognitive and social constraints on actors. Interrelated elements, such as the ones included in their model, help to explain the logic behind how companies can reach their goals.

Amit et al (2010) present literature on value networks as a relevant emerging theoretical framework which may help deepen the understanding of a how a business model can be perceived. The value network concept (e.g. discussed by Parolini, 1993 and Allee, 2002) build on strategic alliances. The difference between looking at a business model through the lens of a *value network* rather than a *value chain* (e.g. Porter, 1985) is that it enables a systemic network-based view of a business model rather than a firm-based perspective. Literature on value networks does also bring in a broader perspective by focusing on social and multidimensional value creation, in addition to economic. (Amit et al, 2010)

2.1.2 Social entrepreneurship – multiple value creation and hybrid organizational milieus

Literature on social entrepreneurship encloses many thoughts and models on multidimensional value creation. A recent publication on social entrepreneurship edited by Nicholls has gathered various views of the concept by academics as well as practitioners. Nicholls describes the concept as relatively new and therefore often a bit fuzzy (2008). From his point of view, the concept involves two main components; a social mission and innovative approaches to reach those goals. For a social entrepreneur, it is the social mission, e.g. contributing to improve health care or poverty alleviation, which is the main reason for activities rather than the financial revenue (Nicholls [ed.], 2008, pp.12-13). As far as the social mission component goes there seem to be little disagreement between the views that are presented in this book (Yunus, 2008; Kim Alter, 2008; Boschee, 2008; Emerson, 2008)

Perspectives on the entrepreneurial part of the concept seem to be more diverse. Nicholls is describing the organizational milieu of social entrepreneurship as a hybrid between private-for-profit, public and volunteer activities where the actual financial model adopted depends on available funding and can be provided by grants and/or earned revenue. This view of the social entrepreneur – as someone engaged in activities which generate anywhere from no cost recovery to full cost recovery – is shared by most of the other authors. Boschee on the other hand, limits the usage of the social entrepreneur concept to someone who uses "earned income strategies" to achieve a social objective. From his point of view it is important to not translate "innovate" into "entrepreneurial", if no independent revenue streams are produced (Boschee, 2008, p.360). The hybrid character of the social entrepreneur is still something which he agrees with other authors about.

Yunus (2008) and Emerson (2008) are two authors which have outlined their thought about the hybrid, and multidimensional, feature of social entrepreneurs – a feature they regard as more natural than a uniform one. Yunus, founder and managing director of the Bangladeshi Grameen Bank, have received several awards for his involvement in the Grameen project in relation to microfinance etc., and can be seen as a front figure within social entrepreneurship.[5] Yunus emphasizes the fact that human-beings are multidimensional, and often have several goals with our actions, which can also be true in business settings. From his point of view, "social entrepreneurship" is a concept which attempts to override the commonly dichotomized view between the market and the public sector, where the market is seen as the sphere which focuses on profit and the public sector as the sphere which focus on social value creation. Emerson, who is also skeptical to one-dimensional models, has developed a model which he refers to as the blended value map. The idea with this model is to look at every organization as contributing to a blended value. The for-profit organization has social and environmental impact along with producing economic revenue, and the non-profit organization is contributing to economic value.

2.1.3 Public networks may enable complex value creation

Agranoff (2007) has studied networks within public organizations and suggests that these networks lead to an exchange of and pool up of resource which enables complex problems to be identified and solved. The interests of the involved actors do often but not necessarily align. What is important for a functional public network is that self-interest in balanced with community interest. Whenever activities within the network can create synergies with core businesses of the participating organizations there is a strong incentive for successful cooperation. Potential benefits of a network include sharing and accessing resources such as financing, expertise and human resources within the network, and enabling a sharing of risks. (Agranoff, 2007)

2.1.4 "Stakeholders" in relation to value creation – viewpoints and adopted perspective

Serer et al (2005) discuss stakeholder theory in relation to sustainable development and distinguish between two common perspectives; the *corporate perspective* and the *stakeholder perspective,* where the former represents the traditional view. The

[5] (Grameen Shakti Chairman Biography, n.d.) This project; "Installation of solar home systems in Bangladesh", will be introduced in section 5.2.2.

corporate perspective looks at stakeholders in relation to a firm or an organization, whereas the stakeholder perspective adopts a broader perspective which is centered around issues as such rather than actions and objectives of a firm.

The business model concept can be seen as going hand in hand with a corporate perspective on stakeholders, while the stakeholder perspective is more analogous to broader models of value creation. A classic definition of a stakeholder related to the corporate perspective was introduced by Freeman in 1984; "A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives.'' (quoted by Steurer et al, 2005, p. 277) Owner, suppliers and customers would be examples of various stakeholders in relation to this perspective. From a broad perspective, a stakeholder group can be seen as any group that have an interest in, or can affect, an issue/program/activity or similar.

This thesis will use the stakeholder concept partly in relation to actors that are needed to affect a course of action, e.g. the ICT4MPOWER project or a CDM project, and partly in relation to those that are affected by these projects. The role of ultimate beneficiaries, e.g. patients and the Ugandan population, is not investigated in any detail, but are also addressed indirectly though the exploration of national conditions. The value creation dimension of feasibility is related to all these stakeholders, and is expected to be rather intertwined in the health sector.

2.2 Technology transfer and barriers to SHS

Technology transfer can be described in slightly different ways[6] but are in broad terms referring to the process of transferring equipment and related socio-technical components such as know-how from one region to another. In the CDM context technology transfer is particularly referring to a transfer made between a non-Annex I party and an Annex II party, involving environmentally sound technologies. (United Nations, 1992, article 4, paragraph 5) Literature which discusses technology transfer does often focus on barriers to adoption and diffusion of technology in the host country, and means to overcome these barriers. (Wilkins 2002; Benioff et al, 2004)

The idea behind technology transfer it that it can function as a mechanism to overcome barriers by provision of additional resources in forms of technological, human and financial capital. The same rhetoric is found in the CDM context in relation to the additionality claim – the projects ability to overcome current barriers.
Wilkins addresses CDM as a potential technology transfer mechanism where "partnerships can help spread the investment cost and risks, facilitate the exchange of information and speed up the transfer process" (Wilkins, 2002, p.176) This perspective is similar to discussions on value networks and public networks

[6] For example; "A broad set of processes covering the flows of know-how, experience and equipment" (IPCC, 2000, p. 3 referred to in Hoffmann, V.H. et.al., 2008) and "The diffusion and adoption of new technical equipment, practices and know-how between actors (e.g. private sector, government sector, finance institutions, NGOs, research bodies etc.) within a region or from one region to another" (Wilkin 2002, p.43)

(sections 2.1.1 and 2.1.3) although circled around a more specified problems; how to enable environmentally sound technologies.

Wilkins (2002) has investigated several case studies which convey barriers to the adoption and diffusion of different technologies. His conclusion on common barriers related to SHS are;

- unwillingness to pay, inability to pay, lack of access to credit,
- lack of government policies and incentives
- lack of awareness, lack of confidence, poor management and implementation
- lack of skills and knowledge, lack of supporting networks and infrastructure (in remote areas)
- a lack of standards, subsidies and security.

Wamukonya (2007) identifies similar barriers to SHS; high up-front cost, technical support for installation and maintenance and poor quality. Wamukonya does also include "limited markets" as a barrier. Tran (2010) reviewed literature which covered previous SHS projects and identified proper maintenance as the key challenge for the long-term success of a project.

Important dimensions of technology transfer which have been highlighted are affordability, accessibility, sustainability, relevance and acceptability. (Wilkin, 2002) A project's ability to fulfill criteria with regard to the above mentioned dimensions is something which must be considered. Wilkins points to the benefits of using an integrated approach, where energy targets are integrating with other development goals, rather than being addressed as separate goals. (Wilkins, 2002, p.49)

2.3 Parallels to consider for the empirical setting of the investigation

The empirical setting of the investigation, electrification of health centers, might be looked at from a social entrepreneurial perspective. Health care activities are commonly part of the public sector, but can also be found within the private-for-profit and volunteer sphere. The concrete measures which are taken in order to fulfill the purpose may therefore vary depending on available financing. CDM comes in as one possible way in which additional financing could be achieved

Potential benefits of certain business models, or "models for value creation", which have been drawn from the theoretical review include its ability to allocate resources to a project and establish networks which may enable a sharing of know-how and risks.

3 Empirical setting of the investigation

3.1 Energy and health care in Uganda: current conditions

The following three sections will introduce the current energy situation in Uganda, give a brief about the health structure and the current status of electrification in the health sector. Further findings on the energy situation, policies and ongoing activates are presented in section 3.3. General background facts about Uganda to be mentioned are that the population reached 32,7 millions in 2009, a figure which is expected to be tripled by 2050. (UNFPA, 2009) In July 2010, Uganda had 111 districts according to the Ministry of Local Government, a number which has grown a lot over the last decades. (Status of local governments, n.d.; Government of Uganda, Ministry of Health, 2010) About 87 % of the population is estimated to live in the rural parts of the country. (UNFPA, 2009)

3.1.1 National energy situation

Energy consumption in Uganda is very low. In 2007, primary energy consumption in Uganda was ranked at nr 143 (globally). (Uganda energy profile [2007], EIA, International Energy Statistics) Energy sources are dominated by bioenergy, which is estimated to stand for about 92% of the country's total consumption. Petroleum stands for about 6% and electricity[7] for about 2%. (Uganda Investment Authority, 2009, p.1). It is therefore not very surprising that Uganda is currently one of the countries in the world with the lowest electricity consumption per capita, 75kWh/capita. (Republic of Uganda, 2010, p.49) In Uganda's Development Plan 2010-2015 Uganda's electricity consumption per capita is mentioned as something which needs to be raised in order to: "improve the country's competitiveness and foster accelerated socio-economic transformation" (Republic of Uganda, 2010, p.49). The development plan mentions that it is desirable to raise the consumption level to 674kWh/capita in order to catch up with middle-income countries such as Malaysia and Korea, something which is estimated to require an additional installed capacity of 3500MW. The world average electricity consumption per capita was 2 595,7 kWh in 2005. (Electricity: Electricity consumption per capita [World 2005]. World Resource Institute)

With its low consumption of fossil fuels, Uganda has currently a very limited climate change impact. Indicators from 2007 show that Uganda's contribution to greenhouse gas emissions was 0,1 tCO_2 per capita/year. This can be compared to the global average value which was 4,6 the same year. (CO_2 emissions (metric tones per capita) [Uganda 2007, World 2007], Carbon Dioxide Information Analysis Center) Since climate change is a global problem and many developing countries, including Uganda, are among the countries where effects of climate change hit hardest (UNEP, 2007), the overall objectives of the climate change agenda are still of great value for Uganda.

[7] Electricity to the national grid is primarily coming from large hydro power plants. (Ministry of Energy and Mineral Development, 2007, p.11)

3.1.2 The health care system

The health care structure in Uganda is divided into hospitals (national referral hospitals, regional referral hospitals and general hospital) and health centers of level I, II, III and IV. Health centers at level I are also called village health teams or community health workers. These are not part of any physical structure but are working as a link between the other health structures and the community. The national aim is to get coverage of community health workers in all villages. Insufficient funding and lack of access to training are factors why this has been hard to achieve so far and community health workers are only functional in about half of the districts. To increase the number of trained community health workers and strengthen their role is a part of Uganda's Health Sector Strategic Plan III (HSSP III), developed for 2010-2015. The number of vacancies in other health center levels is also high, with health center II units having as much as 67% vacancies. Despite the many vacancies, HSSP III includes a target of increasing the number of health facilities with 30% by 2015. (Government of Uganda, Ministry of Health, 2010)

There are also private sector health providers. This sector is made up by the Private-Not-For-Profit and Private Health Provider. In total, there are 59 public hospitals and 54 hospitals of these two other types. The number of public health centers are a little over 2000, with an additional 1000 or so other facilities. Traditional and Complimentary Medicine Practitioners are also part of this sector. They are commonly visited by Ugandans but their role is complimentary in relation to the formal sector. (Government of Uganda, Ministry of Health, 2010, p.5-6)

Uganda has local governments which have the main responsibility for district health delivery service in health centers and general hospitals. There is also a sub-district level management function which is responsible for organizing and planning health activities in lower level health centers within the sub-district. District as well as sub-district functions are to coordinate activities with Private Health Providers and Private-Not-For-Profit units. Such coordination is still limited. Since 2001, public health centers are not to charge any user fees. Health units run by the private sector do usually have user fees but do also receive some subsidy from the government. (Government of Uganda, Ministry of Health, 2009, pp.4, 7)

Health centers are generally quite small, with about 2 people working in health center II level, and 10 or more people working at health center IV level. (R. Nabiev, personal communication, 4 January 2010).

3.1.3 Electrification and ICT in the health sector

According to the Ugandan Investment Authority there are about 3000 health units in Uganda which are non-electrified (2009, p.6). Given that the total numbers of health centers (level II-IV) are close to the same number, it can be noticed that this estimation includes almost all counted health centers. Another report estimates that approximately 6% of health centers have access to electricity. (World Bank, 2009, p.90) The Uganda Investment Authority includes a scenario of the electrification potential of health centers by concluding that if 30 % of the health centers got SHS of 300WP installed, this would correspond to 0,27MW.

Regarding community health workers, there do not seem to be any estimation made for the electricity access specifically for this group. Nevertheless, conditions for households in rural areas ought to be somewhat representative. Around 4 percent of the population in rural Uganda is expected to have access some kind of electricity. (World Bank, 2009a, pp.90, 115) The amount of households with grid access in rural areas is expected to be about 2% according to Uganda Investment Authority (2009, p.4). For households and facilities not connected to the grid, diesel generators, car batteries or solar PV are the alternatives which are used to produce own electricity. (Ministry of Energy and Mineral Development, 2002)

The Ugandan HSSP III mentions improved infrastructure for health facilities as one of the key priorities in order to make them function more effectively. To electrify priority health facilities, as well as to enable ICT usage for these ones, is part of this strategy. The ICT prevalence among health units are currently estimated to be 6,4 %, which includes prevalence of radio, TV, mobile phones and computers. (Government of Uganda, Ministry of Health, 2010, pp.103-104, p.20)

3.2 ICT4MPOWER

The establishment of the ICT4MPOWER project is the result of a request from the Ministry of Health in Uganda directed towards the Swedish Program of IT and Communication in Developing Regions (SPIDER) to help with establishing an e-health solution for improvement of the health care system. SPIDER involved the Karolinska University Hospital to lead the system development in partnership with Ugandan counterparts. (R. Nabiev, personal communication, 4 January 2010) What was designed was a pilot project to be located in the district of Isingiro, situated in the southwest of Uganda. ICT4MPOWER started in April 2009 and has a timeline until March 2012. ICT4MPOWER Executive summary 1.0, 2009)

The objective of the project is to improve the information flow from the community level to the district and regional level, up to national level. A better information flow improves the prerequisites for organizing preventive care and treatment. The aim is also to help empower health workers by providing electronic advises related to their work practice. After investigating different options it was decided that the system would be computer-based. Computers, and possibly, external servers are therefore the electronic infrastructure which will require electricity at a district level. As mentioned in the introduction - the objective is that the pilot project may function as a proof of concept for a scalable solution. (R. Nabiev, personal communication, 4 January 2010)

3.2.1 Project Partners

Governmental bodies: The governmental bodies involved in the project are the Ministry of Health and the Ministry of ICT. The Ministry of Health (MoH) is the project owner of the ICT4MPOWER project and the party that initiated the project.

From the executive summary of the project it is stated that; "as the sole government department charged with the health care of Ugandans the ministry of health will provide leadership and direction of all project activities." Since the project is designed as an e-health solution the Ministry of ICT does also have a key-implementation role. (ICT4MPOWER Executive summary 1.0, 2009)

Funding partners: The funding partners of the project are; the Ugandan Communication Commission (UCC) as well as SPIDER. UCC is indirectly dependent on the Ministry of ICT since the funding to the project uses the ministry's rural communications development fund, RCDF. (ICT4MPOWER Executive summary 1.0, 2009) SPIDER is a collaboration between SIDA – Swedish International Development Cooperation Agency, and Stockholm University. (Overview: about SPIDER, n.d.) The total budget of the project is 16 million Skr, of which approximately half is sponsored by SPIDER and half by UCC. (R. Nabiev, personal communication, 4 January 2010)

System developers: The partners with main responsibility for the system development are the Karolinska University Hospital (Karolinska) and Makerere University. Karolinska is official project coordinator and focal point for project management issues. Since August 2010 there has been a technical coordinator from Makerere as well as from Karolinska. The main focal point is still Karolinska. (R. Nabiev, personal communication, 4 January 2010)

Other collaborative partners, such as Mbarara University Teaching Hospital, the Karolinska Institute and the Isingiro District [local government], are also mentioned in the executive summary of the project. (ICT4MPOWER Executive summary 1.0, 2009) These partners are not part of the daily development activities though, neither are they involved in the funding mechanisms of the project.

3.2.2 Project scope and the energy component

The Isingiro district has a population of approximately 400 000, and has about 54 health units, of which four are level IV units, seventeen are level III units and remaining ones are level II units.[8] (ICT4MPOWER Executive summary 1.0, 2009) The detailed outline and scope of the ICT4MPOWER has been a work in progress, meaning that the operational scenario of the pilot project has been changing during the time of this thesis work. The Ministry of Health was initially interested in creating a system which included community health workers as well as health centers (II, III and IV). In this scenario the expected total number of health workers, which would directly use the system, was estimated to be around 1200, of which around 90% were expected to be community health workers. Limited resources led to a change of focus, and in October 2010 it was decided that only health centers would be targeted in the project scope. To enable community health workers to be

[8] According to the Isingiro District home page, the number of governmentally owned health centers are 52. (Isingiro District: Health, n.d. Retrieved 2010-12-07 from http://www.isingiro.go.ug/districtprofile_category.php?id=10). If the total number is 52 or 54 does however not comprise any relevant difference to the purposes of this thesis.

part of an electronic management system is however still a future priority of the Ministry of Health. (R. Nabiev, personal communication, 4 January 2010).

In the beginning of the project it was recognized that electricity generation is insufficient in Isingiro in order to accomplish project goals. Initial surveys concluded that there were no or almost no electricity at all. To plan and arrange for a sufficient energy supply has therefore been included as a separate component in project plans. SHS were identified as a suitable energy solution and purchase of equipment for SHS have been part of the budget prior to starting this thesis work. The general division of finance is designed in a way where development work performed by Karolinska is sponsored by SPIDER. Development work at Makerere, including technical equipment needed for the project, is financed by UCC. The budget for SHS has hence been placed on UCC. The budget for energy was originally covering less SHS units than what was expected to be needed for the full implementation (1200 end users) of the e-health system. (R. Nabiev, personal communication, 4 January 2010)

The plan for the energy component is that the installed solution will cover energy needs related to computers needed for the e-health solution, but also other important equipment such as lighting devices and refrigerators. Tran (2010) made an initial estimation of the energy requirements for the health centers and suggests that health centers level II, III and IV need 120, 300 respectively 1200 W. In these calculations it is assumed that laptops would be used, which require less energy than stationary computers. If all 54 health centers, as mentioned above, were to be included in the ICT4MPOWER project this would correspond to a total installed capacity of about 14kW (≈260 W per HC in average, i.e. quite similar to the 300W per unit which was mentioned in the investment scenario by Uganda Investment Authority).

A field study which investigated the energy baseline situation and requirements at several Isingiro health centers were conducted in October 2010 by a team from Makerere University. The study covered four health centers IV, an additional four health centers III and two health centers II. Finding from these units showed that most health centers had some, but limited, electricity supply. A few had access to the grid, some had solar systems installed and some had access to diesel generators, or a combination of these. These electricity implementations had been carried out by the local government or different NGOs. The grid connected units did all have back-up sources. The report concludes that most solar PV systems were poorly installed and maintained and also that most health workers seemed to prefer to be connected to the grid. (Makerere University. Energy and Infrastructure team, 2010) Given the results from this field study, energy requirements related to the project might be somewhat lower than 14 kW (if the same assumptions as in above paragraph are applied).

3.3 Ugandan energy policies and programs

3.3.1 Renewable energy

The overall energy policy goal stated in Uganda's energy policy from 2002 is to;

> "[...] meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable way" (Ministry of Energy and Mineral Development, 2002)

The entity which is responsible for the energy sector and hence major governmental incentives in the area of renewable energy, and solar energy incentives is the Ministry of Energy and Mineral Development (MEMD). (Ministry of Energy and Mineral Development, 2002) There is also the Rural Electrification Agency (REA), a semi- autonomous entity established under MEMD with an operational mandate of carrying out rural electrification goals. (About REA, n.d.) The government established a policy in the beginning of the decade which aimed to increase the access to electricity in rural areas from 1%, which was the estimated ratio at that time, up to 10 % within the next 10 years. REA is to achieve this target of 10 % by 2012. (About REA, n.d.)

Uganda's most recent policy document specifically on renewable energy is from 2007. The overall renewable policy goal is to reach a share of "modern renewable energy" of 61 % of the total energy consumption by 2017, ("modern renewable energy"; e.g. renewable energy sources that can be transformed to electricity and biofuel) (Ministry of Energy and Mineral Development, 2007). The renewable energy policy includes targets related to five different programs. Two of these programs relate to SHS. The "modern energy services" program aims to install 700kWp SHS by the year 2017. ICT usage is part of what modern energy services refers to. Solar PV is also part of the energy sources which is to be used in the rural and urban-poor electricity access program, which aims to electrify 625 000 households by 2017 (Ministry of Energy and Mineral Development, 2007)

The largest energy projects which are currently undertaken in Uganda are the Bujagali hydro power plant (250 MW). In addition to this four other large scale hydro plants are currently planned (700 MW, 700MW, 400MW, 130 MW). Solar PV is not among the larger planned investments (Republic of Uganda, 2010, p.49)
One major framework for electrification initiatives on the national level has been identified; this is the Energy for Rural Transformation (ERT), which started in 2003. This framework sets up overall strategies and facilitates resources to rural electrification and will be further described in the following section.

3.3.2 THE ERT program: health and ICT two of the prioritized areas

The ERT program is arranged as a three-phase adaptation loan. The first phase of this program, ERT I, was completed in 2009. A second phase of the program, ERT II, is now up and running with a deadline in 2013. The ERT program is primarily funded through loans by the International Development Association (IDA), a development institution under the World Bank. Grants from Global Environmental Facility (GEF) and resources from Government of Uganda are also co-financing the program. The total budget of ERT II is 93 million US$, where GEF grants accounts for 9 US$. MEMD is the entity with the main responsibility for the success of the activities under the ERT program. (World Bank, 2009a)

Programs under ERT II are divided into 3 main components;

Component 1: Rural Energy Infrastructure
Component 2: Information Communication Technologies (ICT)
Component 3: Energy Development, Cross Sectoral Links, Impact Monitoring.

ERT involves several direct participating organizations on the governmental level and local government level. UCC is the organization with the main responsibility for the ICT component. The last component includes electrification of health centers, where Ministry of Health is the main cooperating organization. The health component is further addressed in the next section (section 3.3.2.1). Energy packages for water and education are other parts of this component. Outcomes of the ERT I (2003-2009), primarily related to the first component, and which are continuing during ERT II include the following; (World Bank, 2009a)

- A Master Plan for renewable energy, the so called IREMP, was formulated by REA.
- Establishment of a PV Target Market Approach (PVTMA)
- Establishment of a private sector component of the ERT program; the BUDS-ERT framework

IREMP is developed to guide and help prioritize investment in renewable energy which will be financed under ERT II. For off-grid projects, it is generally required that these are located in areas with relatively high income levels and affordability. Electrification of health and education facilities is considered to have significant economic benefits and is therefore exempted from any financial analysis. (World Bank, 2009a, pp.14-15)

The PV Target Market Approach (PVTMA) is an action plan for accelerating the uptake of solar PV in Uganda. The implementation plan of the PVTMA is divided in two phases; a first one which begun in 2007 and the second one ending in 2012. PVTMA is coordinated by the Rural Electrification Agency. (Rural Electrification Energy, 2007) “Target” refers to a specific group of potential users of solar PV systems. A target group could be confined to a region (e.g. an income zone) or bound by characteristic, for instance a common employer (e.g. Education Service Commission)” (Rural Electrification Energy, 2007, p.5)

BUDS-ERT is the private sector component of the ERT program. The BUDS-ERT scheme and PVTMA scheme are both including access to subsidies, which together accounts for maximum of 45% of investment costs. Subsidies are only available to customers that take loans purchasing the equipment. (Rural Electrification Energy, 2007, pp.11-12)

All in all, ERT activities are considered crucial for the continuous development of the market for renewable energy technologies and the implementation of these technologies. This need for support is one of the rationales behind the involvement of the GEF. The GEF grant projects in developing countries which aim to protect the global environment and functions as a funding mechanism related to multilateral environmental conventions, such as the UNFCCC (What is the GEF, n.d.). What is claimed in relation to the GEF involvement is that;

> "Without the support of ERT II, the market would in all likelihood not continue to grow and might actually stagnate and go into decline. Uganda's energy sector would continue to rely on traditional fuels, with increasing fractions being derived from fossil fuels and large hydro." (World Bank, 2009a)

3.3.2.1 Health sector priorities: SHS and grid-connection

The health sector forms part of the third ERT II component. The priorities of the health component are to:

> "[…] improve delivery of health services in rural health centers through increased access to modern energy services and ICTs." (World Bank, 2009a, p.52)

The energy supply is to cover energy demands related to the second Health Sector Strategic Plan (HSSP II). HSSP II outlines a national minimum health care package for different health center levels. Energy services for lighting, refrigeration, health education, communication and data management are some of the demands that are mentioned. The total amount of installed systems in health centers during ERT II are expected to be 464, corresponding to 387kW installed capacity. The health component includes health centers II – IV in twenty-four districts, primarily located in the Northern parts of Uganda. Isingiro is not part of these districts. (It is however part of the education component) (World Bank, 2009a)

Electricity will be provided to health centers by connecting them to the grid or implementing solar PV systems. A standard solar PV energy package was developed for the health sector during ERT I, and will continue to be used in the second phase. For the lower level health centers this installment is to include medical buildings as well as staff houses. The solar packages will be supplied, installed and maintained by private companies through contracts with the Ministry of Health and respectively District.

All health centers that are located within 500 meters of the national grid are to be connected to the grid. And for health centers IV, all those within 1 km will be connected. The ambition regarding solar energy packages is to implement these in all health centers IV that are unconnected to the grid and to 75 % of the unconnected health centers II and III. (World Bank, 2009a)

The World Bank's summary on ERT I achievements conclude that 155 solar PV systems, a total capacity of 117,2 kW were installed in health center. This is estimated to correspond to the avoidance of 90 tCO_2 per year, were mini-grid electrification with an emission factor of 770 tCO_2 /MW-yr is assumed to be the baseline. (World Bank, 2009a, p.118) Although the installed capacity is in line with the projected, it is mentioned that there were many disagreements between Ministry of Health on the one side and The World Bank and the Ministry of Energy and Minerals Department on the other side which delayed the implementation of the solar packages. (World Bank, 2009a, p.13)

3.3.3 Policies concerning CM

Under UNFCCC, developing countries are to submit a technology needs assessment. This document states the countries priorities on climate change mitigation and adaptation strategies, and should be used to guide the initiatives of developed countries when providing resources and investing in technology transfer activities. (UNFCCC, 2006) Uganda has submitted one such assessment. In the document, from 2006, solar PV is presented as the forth most prioritized technology for the country. (Ministry of water and environment, 2006)[9]

In Uganda's National Development Goals 2010-2015, the provision and promotion of CDM initiatives is mentioned as a strategy to achieve its objective of a low carbon economy development path. To lower overheads for CDM participation is mentioned as something which is important in order to better access the mechanism. (Republic of Uganda, 2010, p.317)

3.4 Summary of findings related to the scope and prerequisites for SHS investment potential in health centers

This section will summarize some of the prerequisites which have been identified in this chapter regarding the scope of a potential CDM project. This is done independently from any legal considerations.

Given the assumptions about the scope of the ICT4MPOWER project and energy requirements per health center level outlined in section 3.2.2, the total installed capacity needed for the ICT4MPOWER is approximately 14 kW - or somewhat lower. Although the objectives of the ICT4MPOWER are unique with regard to the specific functions of the e-health system which are being developed, it is clear that ICT usage within the health care system is addressed and prioritized independently from this project at health centers level II - IV.

[9] This prioritization was made using a multi–criteria analysis including different sustainability goals.

If the same energy requirements as those outlined for the ICT4MPOWER project (per health center level) were applied on a national scale, and it is assumed – in line the Ugandan Investment Authority – that there are currently about 3000 non-electrified health units. And furthermore, that the ratio between different health levels are similar to that of Isingiro, this would result in national electricity requirements for health centers (level II – IV) of approximately 770 kW (i.e. still less than 1 MW). If this is a realistic investment potential for a CDM project is however quite uncertain. Factors which are expected to affect this potential are outlined in below paragraphs.

It is clear that statistics related to national health and electricity conditions and service demand are quite uncertain. Since the Ugandan population is expected to be growing over the coming period and the demand of health services are already larger than the services which are provided by established health centers, the electricity demand is likely to increase over the forthcoming years. Uganda is a LDC and has low electricity access in general. These can be seen as indications that the health service demand, and in turn also electricity demand, would increase for each health center level if economic conditions improved. The types of equipment which is used, e.g. stationary computers instead of laptops, are other factors that affect this estimation.

Meanwhile the total electricity demand is likely to increase, there are ongoing electrification activities which partly, or fully, help to cover the electrification needs of health units. These activities are governmentally coordinated, such as the ERT program, and also performed by various local actors, as examples from Isingiro health centers showed. The Isingiro field study from October conveyed that the current conditions turned out to be more fortunate, in terms of electricity access, than what was assumed. It is not unlikely that similar, nationally unknown, initiatives are taking place in other districts.

Prerequisites for the investment potential of SHS for a CDM project does also depend on the total available funding; how much the CDM mechanism could fund in relation to the amount of other sources of funding that can be localized. At the national level, it is clear that financial constraints are holding back investments in energy infrastructure, as well as the scope of trained health workers and investments in the health sector in general. The financial arrangement for the ICT4MPOWER project is at this date more or less in line with the planned investment. Given that the project still hasn’t reached the implementation stage, there are however remaining challenges, not least for the long term operation of SHS.

All in all, the electricity demand will likely increase, along with that some of the current needs are being covered. The rate by which the demand can increase in reality is intimately connected to general economical conditions. Given these considerations, and that national installments may already need somewhat larger capacity installments per health center level, somewhere around 1 MW might serve as an approximate indication of the investment potential in health centers level II-IV over the next years. If community health workers were to be included this potential would be significantly higher given the large number of these health workers. After having been excluded from the ICT4MPOWER project, they are neither part of any identified ongoing electrification projects.

Figure 3 provides an overview of how the various described factors are expected to affect the national investment potential. As in any complex social situation, there is no exhaustive description of factors and interdependencies. Figure 3 does primary aim to clarify the relationship between the assumptions made in this section.

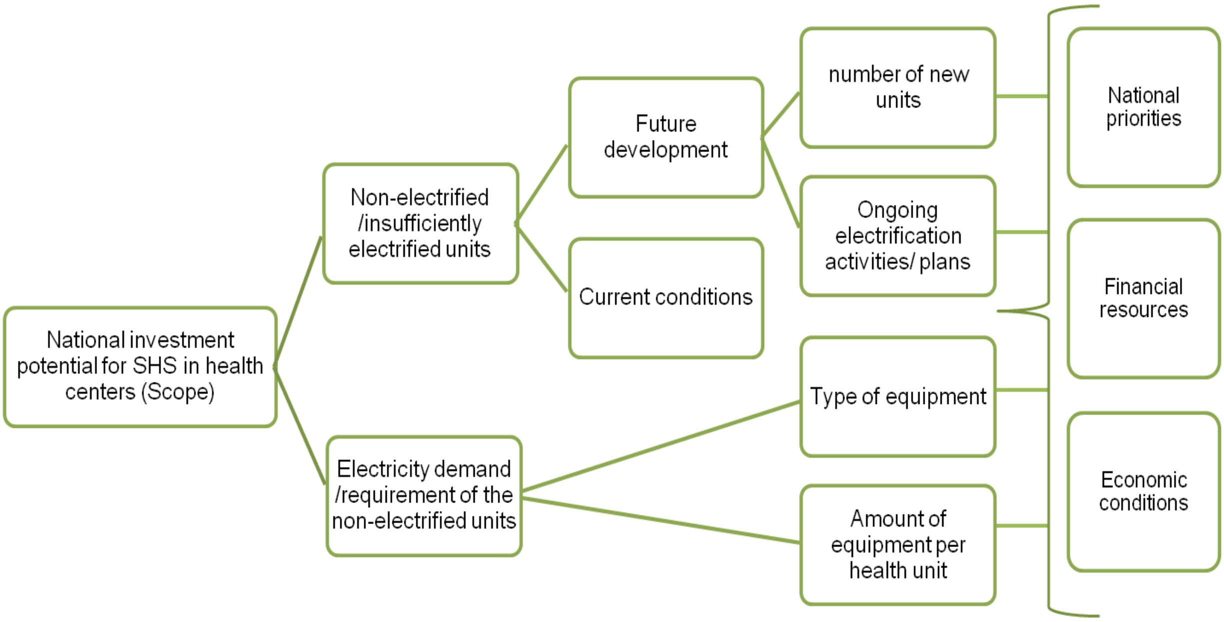

Figure 3: Prerequisites which affect the national investment potential for SHS in health centers. (Source: own compilation)

National priorities, financial resources and general economical condition in the country are expected to affect all the factors outlined to the left of these ones.

4 The carbon market

Before looking more in detail into the legal structure of the CDM framework and ways in which a Ugandan SHS project could be arranged, Chapter 4 will describe the structure of the carbon market and look at common CER prices.

4.1 Kyoto regulated carbon market and voluntary markets

The Kyoto Protocol and its flexible mechanisms were a starting-point for the carbon market. Each of the developed countries which have ratified the Kyoto Protocol has established, or is in the process of establishing, compliance mechanisms. A compliance market is arranged as a cap and trade structure, where the participants in the market are legally bound to make sure that a certain cap is not trespassed. The EU ETS is currently the biggest compliance market. (European Union Emissions Trading Scheme (EU ETS), n.d.; Kyoto Protocol: Clean Development Mechanism (CDM) and Joint Implementation (JI), n.d.)

Apart from the UNFCCC based carbon market there is also a voluntary market. The voluntary market is made up by voluntary compliance mechanisms, such as the Chicago Climate Exchange (CCX) and pure offsets. The voluntary compliance market is quite widespread in the US, which is not very surprising taking the fact that the country is not part of the Kyoto compliance mechanism. The offset market is made up of private persons and companies that chose to compensate for emissions, for any given reason. Climate compensation for flights is one example of this.

The voluntary market has a potential to function as a complement to the Kyoto compliance markets. Since the process of registration may take some time and the crediting period for CERs only can commence after the registration is completed, there may be a timeframe when the CDM projects is operational but not entitled to CERs. During this timeframe the emission reductions may be sold as VERs, which are verified or voluntary emission reduction units, in the voluntary market. (Voluntary Emissions Reduction (VER) Introduction, n.d.) CERs can also be sold to the voluntary market, see section 4.2 below.

4.2 Market prices

The market value of the emission reductions are not regulated by the UNFCCC secretariat in any way. (Frequently asked questions, n.d.) The CER price is primarily influenced by the EU ETS market, since this is the largest market. (Schneider et.al., 2008, U. Raab, personal consultation, 13 September, 2010) According to a market overview published by the carbon finance unit at the World Bank, contracts between sellers and buyers are commonly regulating CER purchase prices in relation to the spot price on CERs at BlueNext or ECX front contract prices (BlueNext and ECX are both linked to the EU ETS scheme). A certain discount of these market prices is commonly given to the buyer. The proportion of this discount depends on what stage in the project cycle the project is when a purchase contract is signed. CERs from projects which are at validation stage when the contract is signed are about 20% to

30% lower in price. The price per CER for projects that are registered or about to be registered are between 10% and 20% lower. (Ambrosi et al., 2010, p.46). The spot price on CERs on BlueNext are currently (29 November 2010) 11,89 €, and ECX prices on CER futures for December are 11,7 € (BlueNext, 29-11-2010; ICE ECX CER Futures, n.d.) The price variation of the BlueNext spot price over the last 2 years (28-11-2008 – 29-11-2010) can be observed by figure 4 below, where the price in € is indicated on the vertical axes.

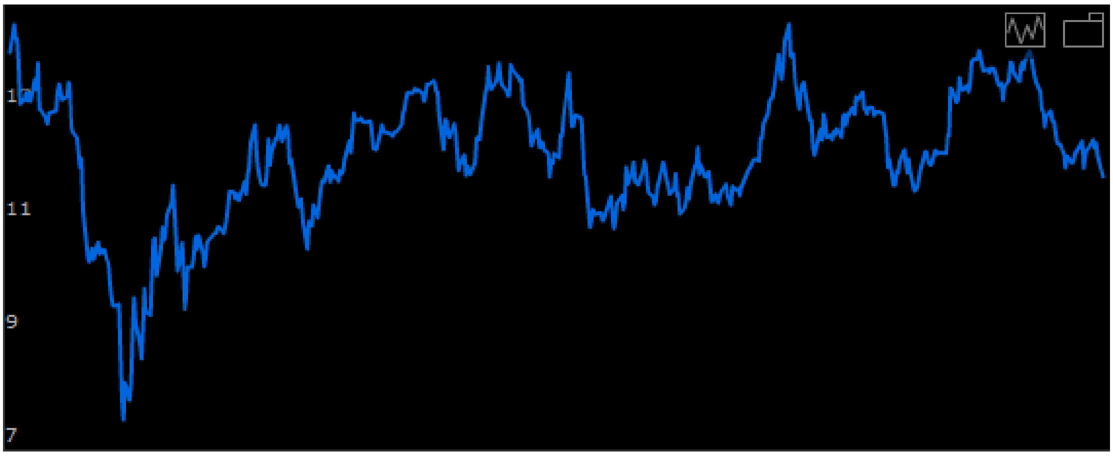

Figure 4: variation of the spot price at Blue Next 28 November 2008 - 29 November 2010. (Source: BlueNext Statistics Graphical analysis, 29-11-2010)

As seen by the graph in figure 4, the price has varied between a little over 7 to a little over 14 € during this time period, but mostly been in the price range around 12 €. The current price (11,89 €) is therefore somewhat representative for the latest time period.

CERs from small renewable energy projects are among the most attractive on the carbon market, this is especially so for projects based in LDCs. Assets from these types of projects have for this reason generally been traded via bilateral agreements on the so called over-the-counter market (OTC). This market involves voluntary as well as Kyoto-regulated buyers. (Ambrosi et al, 2010) Market reports from 2010 show that CDM (and JI) credits sold to voluntary buyer were receiving the highest market price. Their average price in 2009, \$15.2/tCO_2, represents more than the double of the average OTC price. Of the different renewable energy assets, solar energy is the highest earning activity, with an average price of \$33.8/tCO_2. (Ecosystem Marketplace & Bloomberg New Energy Finance, 2010, executive summary)

4.3 Market development and 2012 uncertainties

Since the current commitment period for emissions reductions end in 2012, the market situation post-2012 is quite uncertain. Most of the post-2012 issues are still being negotiated at the UN level. (U. Raab, personal consultation, 13 September 2010) The latest procedures in Cancun (29 November to 10 December) did not succeed to finalize negotiation on new reduction quotas. It was still agreed that such quotas are needed and that the flexible mechanisms should continue. (Draft decision [-/CMP.6]: Outcome of the work of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol at its fifteenth session, paragraph 6) Forthcoming meetings will tell if these statements result in updated agreements on actual quotas.

Rules that will apply to the EU ETS scheme have however been outlined in a directive from 2009 (2009/29/EG). This directive stipulates[10] that credits generated from projects located in a least developed country, registered post-2012, should be accepted at the European market regardless of how the international negations goes, and will continue to be so up till 2020 (provided that the projects clearly fulfills relevant CDM standards). (Directive 2009/29/EC, paragraph 31) Credits generated after 2012 are expected to be lower than those generated up to pre-2013. The price situation is however very uncertain. LDCs do also have a special status in the market so far project, why these countries have a better prospect. (U. Raab, personal consultation, 13 September 2010)

[10] The actual formulation is however a bit vague, and refers to that it is "appropriate" that this be the case.

5 CDM project types and pipeline

This chapter will initially, in section 5.1, describe the categorization of CDM projects and identify alternatives for SHS projects. Requirements for additionality will be outlined. Section 5.2 will introduce previous projects in the CDM pipeline and map the existing experience of the mechanism. The following sections will explore the additionality criteria (5.3) and baseline calculation (5.4) in relation to the Ugandan scenarios. Further criteria for CDM are presented and discussed by the final section (5.5).

5.1 Categories of CDM projects

As mentioned earlier (section 1.1.2), all CDM projects need to make use of an *approved baseline and monitoring methodology*. There are two main categories of methodologies; those related to *large scale* projects and those related to *small scale* projects, where small scale methodologies are applicable to projects of less than 15MW installed capacity.[11] These categories do each have subcategories, depending on how emissions reductions are achieved.[12] For both small scale and large scale projects, the full scope of the CDM project need to be defined when the projects is designed and registered.

In order to provide more flexibility in the design and development of CDM projects, further CDM frameworks and design options have been introduced. Programmatic CDM, so called *CDM program of activities* (*PoA*) is one example of this. A PoA can be described as a CDM umbrella framework, which builds on either large scale or small scale methodologies. The establishment of a PoA has been described as a way to expand and accelerate the reach of the CDM, not least in least developed countries. (UNEP Risoe Center, 2009; Ambrosi et al., 2010) It is also regarded as a framework which enables economies of scale, features that are of special importance for SHS and other distributed energy systems (UNEP Risoe Center, 2009).

A large scale project involving SHS, represents the equivalent of more than 57 600 SHS of 260W each (average needed capacity per health center in the ICT4MPOWER scenario). The suitability for such a large project in any scenario related to the investigated Ugandan context is ruled out beforehand. Large scale project types will therefore not be investigated in any more detail. Small scale methodologies and programmatic CDM have thus been the target of the investigation.

[11] Or less than 15 GWh energy savings for energy efficiency activities

[12] Apart from using predefined methodologies it is also possible to design a new methodology, provided that this design is approved by the CDM Executive Board. (Decision 3/CPM.1, Annex, paragraph 38) This requires additional transaction costs due to development of the new methodology and has not been looked into in any detail. The necessity for such an approach has neither been identified.

5.1.1 Electricity generation by user; scope and additionally

SHS which are not connected to a grid apply to the approved baseline and monitoring methodology called “electricity generation by user”, AMS 1.A[13]. The categorization of the methodology is illustrated by figure 5 below (in bold letters).

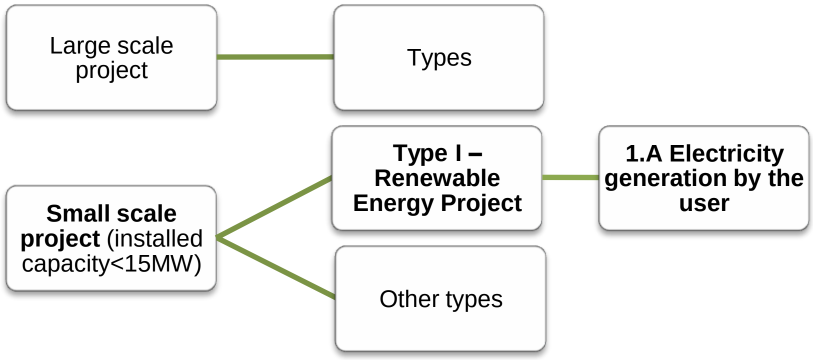

Figure 5: CDM categorization of SHS not connected to the grid (Source: own compilation developed from Decision 3/CPM.1, Annex II, Appendix B)

The definition of this category (AMS 1A, version 14) is as follows;

> “This category comprises renewable electricity generation units that supply individual households/users or groups of households/users included in the project boundary. The applicability is limited to individual households and users that do not have a grid connection […]”*

*grid connection can be accepted under certain circumstances

Indications from the Swedish Energy Agency are that the “electricity generation by user” methodology ought to be applicable to health centers as long as the units are quite small and the technological requirements are fulfilled, e.g. that there is no regular grid connection and the project activities stayed below 15 MW. (U. Raab, personal consultation, 13 September 2010)

Projects that are applicable to the same approved baseline and monitoring methodology do usually have the same criteria when it comes to proving project eligibility requirements, such as additionality. For renewable energy projects there is an exception for very small scale projects, where those with an installed capacity of less than 5 MW have reduced requirements for the demonstration of additionality (EB 54, Annex 15).[14]

It is therefore possible to establish two scenarios of small scale projects;

(1) Small scale renewable energy projects between 5 MW and 15MW
(2) Small scale renewable energy projects below 5MW

[13] “AMS” refers to an Approved Methodology for small-scale CDM project activities
[14] EB 54 was held in May 2010, which makes this simplified rule very recent.

Although it is not likely that a small scale project would be above 5 MW in the Ugandan context, the standard additionality criteria (between 5 MW and 15MW) is still relevant to explore in relation to programmatic CDM.[15] The difference in the additionality criteria is the following;

5.1.1.1 Additionality for case (1); between 5 MW and 15MW

(Decision 3/CPM.1, Annex, Attachment A to Appendix B)

> "Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to **at least one** of the following barriers:
>
> (a) Investment barrier […]
> (b)Technological barrier […]
> (c) Barrier due to prevailing practice […]
> (d) Other barriers […]"

Each of these barriers could serve as an explanation for why another, less climate friendly, technology would have been more convenient to implement if CDM were not considered. The continuation of (a), the investment barrier, does i.e. read as follows; "a financially more viable alternative to the project activity would have led to higher emissions".[16] Technological barriers can refer to a small and uncertain market situation for a contemplated climate-friendly technology which entails larger risks than if another alternative was chosen. Regardless which barrier that is chosen, it should be proven that CDM somehow helps to overcome this barrier. The fulfillment of the additionality criteria in this case is thus not before hand given, but must be argued for in relation to a national and project specific context.

The EB has outlined guidelines on non-binding best-practice examples of how additionality can be proven in relation to small-scale projects. According to these guidelines it is recommended to chose the most relevant barrier and thereafter provide transparent third-party evidence of the existence of this barrier. (EB 35, Annex 34) Raab does also emphasize that it is better to make a strong argument for one barrier, than to loosely discuss all of them. (U. Raab, personal consultation, 13 September 2010)

5.1.1.2 Additionality for case (2); below 5MW

Project activities up to 5 MW which employ renewable energy as their primary technology can prove additionality with reference to *one* of four predefined conditions. The first condition implied that the location of the project may be referred to in the following cases;

---

[15] As section 6.1.2 will notify, it is currently unclear if the simplified criteria would be possible to apply to programmatic CDM.
[16] A full attachment for these additionality criteria is available in the Annex of the thesis.

“(a) The geographic location of the project activity is in LDCs/SIDs[17] or in a special underdeveloped zone of the host country identified by the Government before 28 May 2010” (EB 54, Annex 15)

Since Uganda is a LDC, renewable energy projects up to 5 MW would be considered additional. A reason for why these simplified options have been introduced may be explained by a comment by Cornland; some projects just do not happen, and everyone involved in these activities knows that. (D. Cornland, personal consultation, 27 October 2010) Simplified requirement should hence not be seen as if barriers are no longer important but rather as a beforehand affirmation that there will be some barriers whenever these requirements are applicable.

5.1.2 Program of activities (PoA)

A PoA is implementing a policy, measure or stated goal, and is made up by an unlimited number of CDM Program Activities (CPAs). A PoA can be made up either by large scale or small scale components. The requirement is that all CPAs needs to be of a similar type, which most often means that they need to make use of the same baseline and monitoring methodology, e.g. electricity generation by use, as described above. If the use of multiple methodologies is applied for and approved prior to submission of a registration request for the PoA, this can still be a possible arrangement. (EB 47, Annex 31, paragraph 2) If it from a national perspective would be of interest to implement grid-connected SHS as well as off-grid systems within the same CDM framework, this would hence most likely be a possibility.[18]

A potential lay-out for a program of activities could be represented as follows;

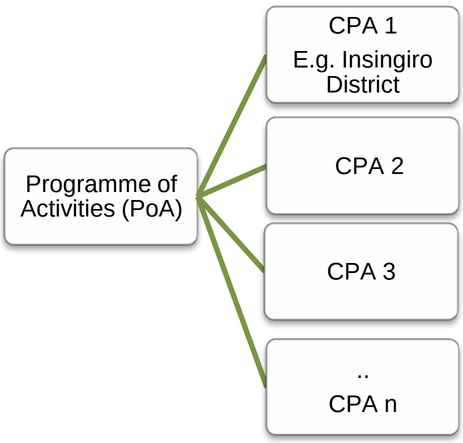

Figure 6: Overview structure of how the hierarchy of a PoA functions. Source: own compilation)

A PoA provide structure yet flexibility which a scalable solution may benefit from;

- By creation of an umbrella framework each new CPA which is added is already somehow designed.

[17] SIDs stands for small island developing states
[18] There is a methodology called AMS I.D which could be applicable to grid-connected systems.

- An individual CPA is unique with regard to its geographical project boundary, e.g. Isingiro District.
- CPAs can be added any time during the lifespan of a PoA (28 years for renewable energy projects). (EB 32, Annex 38, version 2, paragraph 10)

As being the case with CDM projects in general, a CPA can generate credit for either a period of seven years, which can be renewed twice, or for a total of ten years. If the CPAs are added late, there is however no possibility to generate credit when the lifetime of the PoA has passed. (EB 32, Annex 38, version 2, paragraph 10) It is also of importance to notice that a CPAs cannot have a starting date which is prior to the validation process of the PoA. This means that a PoA design document must have been made official prior to construction or start of any real project activity. (EB 47, Annex 29, version 3, paragraph 5 (d); UNEP, 2009) The same thing is valid for CDM projects in general – projects cannot start prior to the validation process.

5.1.2.1 Viewpoints of PoA related to the Ugandan national context

Kallhauge describes programmatic CDM as the most interesting CDM framework for Uganda along with the forest sector. (Angela Kallhauge, personal communication, 20 October 2010) Regarding the relevance of increasing the share of renewable energy such as solar PV, she refers to the Ugandan energy crisis a few years ago, when water basins where dried out and the country became dependent on imported oil. (Angela Kallhauge, personal communication, 20 October 2010) Uganda has no local production of petroleum products and therefore imports all these products. (Energy and Mineral Development, 2002, p.17) Uganda's renewable energy policy from 2007 does also refer to previous periods of draught and the importance of avoiding overdependence on large hydro. (Energy and Mineral Development, 2007, p.13) This is a practical example of why it ought to be of national concern to adopt a broad framework, such as PoA, for increasing the share of renewables.

The concept of "early adopters", actors that are interesting in exploring initiatives and can function as champions for a new technology, is well known within literature on technology transfer (Thorne, 2008). This concept can be related to the design of a PoA where projects can join one by one, and thereby enabling a practical framework for the potential benefits of an "early adopter" model. Since each CPA need to be arranged in line with the initial outlined CPA-PDD, the concept of PoA can be seen as providing a "receipt" for actors which are interested in joining the programmatic framework with additional CPAs. (UNEP Risoe Center, 2009, p.7)

5.1.2.2 Additionality for a PoA

The additionality criteria of a PoA must be proven on a programmatic level as well as on a CPA level. At the programmatic level it must be shown that:

> "[...] in the absence of the CDM either:
>
> (i) the proposed voluntary measure would not be implemented, or
> (ii) the mandatory policy/regulation would be systematically not enforced and that non-compliance with those requirements is widespread in the country/region, or
> (iii) that the PoA will lead to a greater level of enforcement of the existing mandatory policy/regulation.
> This shall constitute the demonstration of additionality of the PoA as a whole"
> (EB 47, Annex 29, version 3, paragraph 4(e))

The formulation of the additionality criteria enlightens the importance of having made a thorough investigation of current policies and ongoing activities related to those policies. If there is an existing policy which is similar to the measure of goal of the PoA it is, as noted in the above criteria, crucial to demonstrate that this policy is either not implemented as it should or that the new measure go *beyond* the scope of the current policy. The CDM rulebook interpretation of the additionality criterion at the programmatic level is that there are no specific restrictions of the content in the stated policy or goal other than that it must result in emissions reduction which are additional. (Requirements for a Programme of Activities, n.d.)

The additionality criteria for CPAs depend on which methodology that is used for these projects. How additionality is to be demonstrated at CPA level needs to be outlined in the PoA design document as well as in the CPA design document. (EB 47, Annex 29) Since the simplified additionality criteria, outlined in section 5.1.1, is relatively new, it is still unclear how this relates to the programmatic framework.[19] This is to be clarified soon and may therefore revise prerequisites related to additionality. It may seem logical that a PoA of no more than 5 MW in total could make use of the criteria. On the other hand there is no predefined limit of the total size of a PoA which might be a reason for why it would not be applicable.

5.1.3 Bundling of projects

An arrangement referred to as "bundling" have also been covered. To bundle projects means to bring together several projects for a unified validation. This means that all activities that are to be included in the bundle have to be identified at an early stage in the project cycle. (Decision 4/CMP.1, Annex II, paragraph 19) The portfolio of project activities in the bundle is seen as a single project activity. The intent to bundle must be indicated at the registration stage. All activities included in a bundle need to have the same crediting period. In order to make use of small scale

[19] Matters on this is to be clarified by the EB and was still unresolved in late January 2011. (E-mail correspondence via A. Kallhauge, 28 January 2011)

methodologies the total capacity installed under the bundle cannot be larger than 15 MW, which is the same as for the single small-scale project. (EB 21, Annex 21)

The possibility of bundling is something which further increases the flexibility of the CDM framework. Projects within the same bundle are still distinctive with regard to e.g. technology and baseline. (EB 21, Annex 21, paragraph 3) It is also possible to use bundling in combination with programmatic CDM. (Angela Kallhauge, personal consultation, 20 October 2010) Further details on bundling will be left out by this thesis. What is noted is simply that is quite different and less flexible than a PoA, but that it compared to a regular small-scale activity still improves the design options of a CDM project.

5.2 CDM pipeline – identifying Ugandan and solar PV experiences

This section will review the current CDM pipeline in order to get an overview of the current situation and identify existing PV projects and Ugandan experiences. Projects which are identified as being of special interest have been studied in more detail by reviewing their PDDs. These projects will be briefly introduced in this section and returned to in later sections as additional input on specific topics, such as baseline calculations, revenue expectations and organizational structure. A previous analysis of technology transfer contribution among CDM projects will also be covered in this section.

5.2.1 Regular CDM projects and identified PDD case studies

African countries have been underrepresented as host-countries for CDM but are on their way to catch up. In Africa there are a total of 148 CDM projects in the pipeline (not including programmatic CDM). This number can be compared to the total number of over 5000 projects. Thirteen of these ones have Uganda as their host country, and out of them there are only two which been successfully registered. (UNEP Risoe CDM/JI Pipeline Analysis and Database November 1st 2010, 2010) These are a reforestation project and an electrification project which includes hydropower and a HFO-fired generator (ref. # 775 and 1578), which means that there are currently no CDM solar projects in Uganda.

The result from sorting all projects in the pipeline on sub-type, indicating the technology used, shows that there are a total of 50 projects indicated as solar PV project. 20 of these are successfully registered. (UNEP Risoe CDM/JI Pipeline Analysis and Database November 1st 2010, 2010)[20] The total installed capacity for the registered solar PV projects are varying between less than 1 to 24 MW. What might be of more interest though are the estimated annual emission reductions, which are reaching between 0.6 to 39 ktCO_2 per year for the first crediting period of these projects (7 or 10 years). (UNEP Risoe CDM/JI Pipeline Analysis and Database November 1st 2010, 2010)

[20] Note: the Bangladesh solar project (to be mentioned in 6.1.2) is included in this list and marked as "validation stopped", probably since it is handled as a programmatic CDM.

Many of these projects are making use of AMS 1.D, which is the methodology adopted for grid connected renewable electricity generation. Three projects are registered and making use of AMS 1.A (electricity generation by user methodology). These are “Photovoltaic kits to light up rural households in Morocco” (ref # 182), “Rural Education for Development Society (REDS) CDM Photovoltaic Lighting Project” (ref # 2279) and “D. light Rural Lighting Project” (ref # 2699), the last two both located in India.

The two Indian projects are both designed to provide private households with led lighting devices. The project boundary of the REDS project is to supply around 60 000 households in one of India’s districts with led lamps and battery cases. The participating households are listed by an appendix to the project design document. The expected number of lamps are estimated to be 180 000. The D.light rural lighting project uses led lamps, together with a rechargeable battery and a solar module. The geographical boundary is two regions of India, and the total predicted number of systems to be sold under the project scope is 1 million. (CDM-SSC-PDD for project 2699, version 3; CDM-SSC-PDD for project 2279, version 4)

The project boundary of the Moroccan project is to supply 101 500 rural household with solar PV kits, SHS, in predefined areas of Morocco. The electricity is to be used for lighting and television as well as other household electrification needs. (CDM-SSC-PDD for project 182)

The three registered solar PV projects are among the more highly CER generating solar PV projects in the pipeline. A comparison of their expected CER generation and potential revenue during the full crediting period is presented by figure 7 below.

	Rural Education for Development Society (REDS) CDM Photovoltaic Lighting Project	D.light Rural Lighting Project	Photovoltaic kits to light up rural households in Morocco
Expected ER in tCO_2/year	21 000	30 000	39 000
Crediting period (years)	10	10	10
Total revenue perspective in euro*	€ 1 974 000	€ 2 820 000	€ 3 666 000

*Figure 7: Comparison of revenue potential for existing CDM solar projects. (Source: UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010, 2010) *Own calculation where 9,4 € per CER is used to calculate expected annual revenue (same number which will be used in break-even analysis in section 7.2.2)*

5.2.2 Programmatic CDM and identified PDD case studies

There are so far only a limited amount of projects which have taken the opportunity and succeeded to become PoAs. There are currently, November 2010, a total of 5 registered PoAs. (Registered [Program of Activities], n.d.) There are furthermore an increasing number of projects under the process of validation. The first PoA to be accepted was the" CUIDEMOS Mexico (Campana De Uso Intelegente De Energia Mexico) - Smart Use of Energy Mexico" which was registered 31 July 2009.

Two projects of special interest for the scope of this investigation have been identified. These are the "Uganda Municipal Waste Compost Programme", registered 12 April 2010, and "Installation of solar home systems in Bangladesh", the latter one still not registered. (*UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010*, 2010). The Ugandan PoA aims to improve the solid waste management on municipalities in Uganda. This process is currently unregulated and handled through landfills which result is production of non-captured greenhouse gases. Each municipality that join the program will constitute a CPA. The Bangladesh PoA has the overall project goal of commercializing SHS across the country through electrification of rural households.

5.2.3 Technology transfer claims

Seres (2008) have compiled an overview of how CDM projects of different type involve technology transfer (based on PDD information of projects included in the UNEP Risoe CDM /JI Pipeline in June 2008). This compilation shows that for solar energy project, there are so far less than 5% of total annual emissions reductions which can be related to a transfer of both equipment and knowledge. An additional 10%, or slightly more, have led to a transfer of equipment only, and remaining ones included no transfer.

Of all CDM projects in the pipeline there were approximately 36% that claimed technology transfer, corresponding to 59% of annual emission. More than half of these projects involved transfer of equipment as well as knowledge. (Seres, Stephen, 2008)

5.3 Additionality demonstration

5.3.1 Previous demonstration methods

Although it for small scale projects, as outlined in section 6.1.1, is recommended to make use as one convincing barrier, previously registered solar PV projects have referred to several ones. The PDDs of the Indian projects do both include references to investment barriers as well as barriers related to technology and prevailing practice. The REDS project does also refer to "other barriers". The Moroccan project demonstrates additionality by discussing investment barriers, technology barriers, and other barriers.

The Bangladeshi PoA is set out to demonstrate additionality on the CPA level by reference to investment barriers. Each CPA project will demonstrate how the generation of CER revenues enable a flexible financing mechanism which helps expand the reach of the program. Revenues will partly be used to ensure the maintenance of the SHS. (Installation of Solar Home Systems in Bangladesh. CDM SSC-PoA-DD) Additionality on the PoA level is discussed by reference to all of the barriers available for small-scale projects to refer to. The general argument seem to be that there are several barriers for SHS as a commercial activity and no current governmental policy which would make this happen if the activity were not arranged as a CDM activity.

5.3.2 Ugandan options

A Ugandan project not conducted as a PoA could be arranged as a small scale project of less than 5 MW, and hence automatically be considered additional.

Even though it was arranged as a PoA, the total size of the project would most likely still be less than 5 MW (given the national conditions as summarized in section 3.4). It is still not clear though if separate CPAs would need to demonstrate additionality with reference to barriers or if the simplified criteria for renewable energy projects below 5MW could be applied (as outlined in section 5.1.2). In either way, it ought not to comprise a critical legal obstacle. The low share of SHS within the health care and country in general could likely be referred to as barriers. Given findings included in the technology transfer section (2.2), and the Isingiro field study (section 3.2.2) it seem as the logic behind the Bangladesh argument could be applicable to the Ugandan context; where CDM revenue helps cover maintenance costs.

To prove additionality on a PoA level seems to be a bit trickier. SHS for electrification of health centers are in line with national priorities. It is clear that there are many incitements for the investigated project type, namely to install SHS to electrify health units. Current governmental activities run through the ERT program involve this component. To be in line with governmental policies is a risk from an additionality perspective since the programmatic goal must go beyond the national policy to some extent. The policies and activities that are carried out in Uganda do still not seem to be mandatory, which would have made it more complicated.

The current governmental program for electrification of health centers is also limited to certain regions and the current electrification ratio is still low. Electrification for the needs of community health workers are not covered by ERT II. To include community health workers in a CDM program might be one way to beyond current implementation plans and policies. It is clear that more in-depth research (as well as legal expertise) would be needed to make any qualified assumptions regarding if and how a programmatic additionality claim could be made in relation to the empirical target of the investigation. What findings presented in this thesis point to is that it does comprise a potential obstacle.

5.4 Emission reduction potential and baseline calculations

The emission reductions of a CDM project activity is defined as the difference between the baseline emissions (i.e. those emissions associated with the baseline scenario) and the project activity emissions. Project activity emissions are generally considered to be equal to zero for renewable energy technologies such as SHS. For this reason the emission reductions of the project activity are the same as the calculated baseline emissions (Decision 3/CPM.1, Appendix B to Annex; AMS I A version 14).

The concrete methodologies for calculating a baseline is listed in the "approved baseline and monitoring methodology" for different project types. AMS 1.A defines the baseline as;

> "The energy baseline is the fuel consumption of the technology in use or that would have been used in the absence of the project activity to generate the equivalent quantity of energy." (AMS 1.A., version 14, p.2)

In AMS 1.A there are three possible options for calculating the energy baseline, and therefore also baseline emissions. Option 1 calculates the energy baseline based on expected energy consumption in the closest grid-connection. Option 2 looks at the estimated annual electricity output of the project activity, whereas option 3 makes use of a trend-adjusted projection of historic fuel consumption. The third option is only applicable when an existing technology is being displaced, and is especially recommended for lighting devices.

5.4.1 Suppressed demand

To prove that the chosen baseline is relevant is a crucial aspect from a regulatory perspective. (U. Raab, personal consultation, 13 September 2010) This is especially so when a new or additional demand is introduced, such as ICT equipment for an electronic health solution where no such solution existed. The justification of introducing an additional demand has been discussed under the concept of "suppressed demand" by previous CDM projects[21].

The possibility of using a forecasted baseline which is higher than current emissions is outlined in the Marrakesh Accords where it is stated that;

> "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."
> (Marrakesh Acccords, Annex, Modalities and procedures for the clean development mechanism, paragraph 46.)

The very low CO_2 emissions that Uganda has today, in combination with the low electricity consumption (as noted in section 3.1.1) and its status as a LDC ought to

[21] "Suppressed demand" is not an officially establish concept, but has been used by CDM practioners. (U. Raab, personal consultation, 13 September 2010)

comprise such “specific circumstances”. Research findings related to previous projects do however point to that the idea of using a hypothetical baseline scenario is difficult.

The concept of suppress demand is discussed, but not used, in the PDD of the Indian REDS project. The reviewed Indian solar PV projects do both calculate a baseline scenario for kerosene consumption for lighting, which is the most common alternative according to the REDS project, and the only one which is considered relevant in the D.light Rural Lighting Project. The baseline emissions are in both cases calculated by usage of calculation option 3, where a trend adjusted projection of historic fuel consumption can be used.

The REDS project estimates the usage of kerosene consumption with and without suppressed demand taken into account. The former scenario is estimated through a baseline study where interviewees homogenously state that their consumption would go up to a certain level if they could afford it. These findings are however not used for calculating the baseline emissions in the final PDD (version 4). This is due to conservative measures according to the document. A review of the first version of the PDD conveys that the estimations based on suppressed demand initially were used to calculate the baseline. (CDM-SCC-PDD for project 2279, version 1) In that scenario, the annual emission reductions achieved by the project would have been more than the double of the scenario outlined in the latter document.

Möllersten refers to a water disinfection project in Rwanda as an example of another project which have experienced challenges with establishing a baseline, and where “suppressed demand” had been discussed but never used. (Kenneth Möllersten, personal consultation, 9 September, 2010) He mentions that it had to be clearly shown that the baseline really referred to production of clean water, and furthermore, that he didn’t experience any openness [in relation to CDM regulations] to apply the ideas of suppressed demand. (Kenneth Möllersten, personal consultation, 4 January 2010) A review of the CDM pipeline conveys that there are two water disinfection projects in Rwanda which the Swedish Energy Agency has been involved with. These are the only two projects within this category. (UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010, 2010) Neither of the two PDDs include any reference to “suppressed demand” or the like. (Rwanda Natural Energy Project: Water Treatment Systems for Rural Rwanda (Shyira and Fawe). CDM-SCC-PDD, version 1*;* Rwanda Natural Energy Project: Water Treatment Systems for Rural Rwanda (Mugonero Esepan, Rwesero, Nyagasambu). CDM-SCC-PDD, version 1)

5.4.2 Previous calculations and Ugandan ER potential

This section will look at how baseline emissions could potentially be calculated in the Ugandan context. Challenges related to suppressed demand will be ignored at this point, and the most likely alternative options to SHS implementation will be considered.

Both of the investigated projects which deploy SHS (the small scale Moroccan project and the Bangladesh program of activities) are making use of calculation option 2; where the electricity output is calculated. The projects do both assume that emissions related to diesel generators producing the same amount of electricity otherwise would have occurred. The Bangladesh PoA is also making use of option 3 for smaller size SHS, which are related to replacement of kerosene for lighting. The calculations related to kerosene replacement result in higher ER potential than when option 2 is used. This is partly due to that more energy effective lighting devices can be electrified. (CDM-SSC-PDD for project 182; Installation of Solar Home Systems in Bangladesh. CDM SSC-PoA-DD.)

Provided that the SHS would be sized so that all electricity output is used, and the usage includes a variation of equipment; option 2 seem to be the most likely calculation method to use also for the Ugandan scenario. It is therefore the option which this thesis will use to calculate ER potential and break-even scenarios (in section 7.2.2).

Remark: If it could be proved that a certain amount of the electricity always were used for lighting, and replacing kerosene, and installing more energy efficient lighting devices, it might be possible to make use of both option 2 and 3 (similarly to the Bangladesh case). This scenario is however quite hypothetical and no calculations for this has therefore been made.

5.4.2.1 Outlining calculation option 2

Option 2 (as well as option 1) calculates the baseline emissions as the energy baseline times an emission factor, using the following formula (AMS 1A, version 14):

$$BE_{CO2,\,y} = E_{BL,y} * EF_{CO2}$$

$BE_{CO2,\,y}$ = “Emissions in the baseline in year y; tCO_2”. $E_{BL,y}$ = “Annual energy baseline in year y; kWh”. EF_{CO2} = “CO_2 emission factor; tCO_2/kWh”. “For EF_{CO2}, default value of 0.8 kg CO_2/kWh, derived from diesel generating units, may be used.” It may however be possible to argue for a higher value.

Where: $E_{BL,y} = \sum_i EG_{i,y}/(1-l)$

$EG_{i,y}$ = “The estimated annual output in kWh of the renewable energy technologies of the group *i* renewable energy technologies installed”, *l* = “Average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programmes or distribution companies in isolated areas”. This is expressed as a fraction, where 20% is considered a reasonable default value, which however needs to be demonstrated in the PDD.

The annual output, EGi,y, depends on the capacity of the solar PV which is chosen and the solar irradiation in the specific location. The yearly solar electricity potential in Uganda has been estimated to be around 1,5kWh/W, and slightly higher in the northern parts of the country. (Huld et.al, 2005) If default values are used to calculate EF_{CO2} respectively *l*, these factors will equal out and the resulting baseline emissions will be the same number as the annual output (but in a different unit); 1,5 tCO_2 kW-yr (per year and installed kW).

5.4.2.2 ER potential of investigated Ugandan scenarios and preliminary implications

If above assumptions are applied to the estimated scope of the ICT4MPOWER project and national context for health center levels II-IV (see section 3.4) this would result in;

(1) 21 CER/year if 14 kW was installed

OR

(2) 1500 CER/year if 1 MW was installed.

Given results from previous research (section 1.4.3) the ICT4MPOWER project is far too small in scope to benefit from CDM. Even a national scenario would have needed to be more than the double of the above estimated scope to attract carbon d finance.

5.4.2.3 Sensitivity analysis and comparisons with other ER calculations

If compared to the Moroccan SHS project; the assumptions included in above calculations are quite restrictive. Assumptions included in the PDD of the Moroccan project result in more than the three-double potential; 39 000 CER/year for 7,7 MW installed capacity, i.e. a little over 5000 in annual CER generation per MW instead of 1500. (CDM-SSC-PDD, project nr 182) Morocco has a bit better solar electricity potential than Uganda which is part of the explanation. The potential which is used in the PDD; 2,74 kWh/ W, is still higher than what is indicated for Morocco in Huld et.al (2005), applied above. It is hence clear that the solar potential, and thereby ER potential, may vary somewhat depending on which source that is being used.

The emission factor which is chosen for the Moroccan project is 1,9 kg CO_2/kWh, instead of 0,8.[22] One of the reasons for this is that households are considered to be grouped in small hamlets with small size generators which result in a higher emission factor. (CDM-SSC-PDD, project nr 182) Since these conditions might also be applicable to the Ugandan context, 0,8 can be regarded as a quite low estimate.

Compared to the calculations made in the ERT program, the ER potential seems to instead be overestimated. 1500 CER/MW-yr represents about the double ER potential compared to if assumptions included in the ERT program would have been used (as noted in section 3.3.2).[23] Since the ERT baseline referred to mini-grids, which are also implemented under this program, although not for health centers, it may perhaps serve as the most strengthened nationwide baseline scenario. It is also what GEF refers to as the achieved ERs related to health center electrification.

A reason for the lower value seems to be explained by that the implemented mini-grids are made up by small diesel- as well as small hydro –generating plants. (World Bank, 2009a) Findings related to the Isingiro district (section 3.2.2) and to national

[22] 1,9 kg CO_2/ kWh is a default value in the baseline scenario which is being argued for. (Included in AMS I.F, table I.F. 1.)

[23] 770 tCO2/ MW - yr, was calculated to be the baseline for the ERT program.

condition (section 3.1.3) do however both point to that diesel generators is the common alternative for electrification in off-grid areas, apart from SHS.

All in all, the default value of 0,8, and consequently the ER potential of 1500 tCO2/ MW-yr, is still what has been assumed to be a reasonable estimate in this thesis. This section does still illustrate the uncertainties of this value, and points to that it might be possible to double it for certain project boundaries, and perhaps necessary to halve it for others.

5.4.3 Monitoring

The choice of baseline does initially reflect the ex-ante calculation of the expected generation of CERs which need to be part of the PDD. The actual issuance of CERs is based on monitoring reports and ex-poste calculations. For this reason, sufficient monitoring is of major importance. Regarding the requirements for monitoring, AMS I.A (version 14, paragraph 14) states that monitoring shall consist of:

> "(a) An annual 1check of all systems or a sample thereof to ensure that they are still operating (other evidence of continuing operation, such as on-going rental/lease payments could be a substitute);
> OR
> (b) Metering the electricity generated by all systems in a sample thereof."

For a program of activities build up by CPAs using AMS 1.A, the same rules would apply to the CPA level. The choice of monitoring methodology shall be outlined when the PoA is created. A possibility is to use a sampling method on CPA level, and only verify a sample of the total CPAs. It is always required that a record keeping system is set up, so that all monitoring reports can be coordinated. (EB 47, Annex 29)

5.5 Other CDM requirements: Eligibility, environmental impact and ODA

General requirements for CDM, apart from those related to a baseline and additionality, state that CDM projects need to (UNEP Risoe Center and EcoSecurities, 2007);

(3) Comply with the *eligibility criteria* (e.g. *sustainable development criteria*) of the host country and other parties

(4) Not result in significant *environmental impacts* and undertake *public consultation*

(5) Not result in the diversion of *official development assistance* (ODA).

The following three sections will present findings related to these three criteria.

5.5.1 Eligibility criteria

Eligibility is a broad term and is related to basically all types of criteria for CDM. There are eligibility criteria related to participation in CDM as well as project eligibility, where the additionality criterion is among the most central. (Curnow et.al [ed.], 2009) Relevant aspects of eligibility for the Ugandan context, which are not part of other requirements, will hereby be covered.

A country is eligible to participate if it is a party to the Kyoto Protocol, has an approved DNA and is voluntarily participating (3/CMP.1, Annex, paragraphs 28-30). As long as Uganda is voluntarily participating this part is hence fulfilled. If the host country approves its participation depends on whether the sustainable development criteria is considered to be fulfilled. There is no predefined definition of the interpretation of the sustainable development criteria for CDM purposes. The common understanding of sustainable development is that environmental, social and economical concerns are taken in parallel. It is however up to the host country to decide how sustainability can be interpreted in concrete terms and whether a certain project is contributing to its sustainability goals. Host countries do generally relate the criteria to economic growth and job creation, transfer of environmentally sound technologies and skills. (Curnow et. al [ed.], 2009, p.24)

As various sections in chapter 4 illustrates, electrification of health centers (level II – IV), for ICT usage as well as other purposes, are in line with national priorities. This is strength from a sustainability perspective and indicates that a project which included those levels would be considered to be contributing to the sustainable development goals of Uganda. The chances of having a health electrification project accepted as contributing to sustainable development ought therefore not to cause any troubles. If the Ministry of Health were to be part of a CDM project it is even more clear that goals of the project goes hand in hand with national sustainability priorities.

5.5.2 Criteria related to environmental impact and public consultation

An analysis of the environmental impact does only have to be provided if it is required by the host party. (Decision 4/CMP.1, Annex II, paragraph 22 (c)). The National Environmental Management Authority (NEMA) is the Ugandan entity that is responsible for this approval. According to the Uganda Investment Authority, NEMA needs to approve solar PV projects in general (Uganda Investment Authority, 2009, p.8). No findings point to that such an approval would be problematic. It is a national priority to greatly increase the amount of renewable energy, and solar PV doesn't have any reverse environmental effects such as e.g. large hydro may have.

Regarding the criteria of public consultation which needs to be undertaken, this refers to that local as well as global stakeholders must be given the chance to comment on the project. Local stakeholders which are affected by the scope of the CDM project must be consulted prior to the submission of the PDD. (UNEP Risoe Center and EcoSecurities, 2007) This part can therefore be seen as forming a part of an impact analysis. As long as the recommendations and rules concerning public consultation are followed these are neither criteria that ought to create any obstacles. If there for some reason would be local opposition against SHS implementation this could still stop the proceedings of a planned CDM project. Global stakeholder consultation should be possible after that a PDD is uploaded and is merely a standard procedure.

5.5.3 Criteria related to ODA

Whenever ODA[24] is part of the CDM project financing it needs to be confirmed that this does not result in the diversion of ODA (EB 41, Annex 12, Part II). This confirmation is made by the DNA of the Annex 1 party (U. Raab, personal consultation, e-mail, September 13th). The precise understanding of what it means that there is no diversion of ODA seem to be a bit open for interpretation and is largely in the hands of the entity which makes this confirmation. What is clear is that if ODA is used to finance development costs of a CDM project the DNA of the country where this finance origin from must ensure that they do not have any interest in the CERs of that project. According to Cornland, the verification of the fulfillment of this criterion does not go longer than checking that required documents are submitted. (Personal consultation, 27 October 2010) As long as there is no conflict between the origin of ODA and CER acquisition interests, ODA involvement seem to be more or less unproblematic from a regulatory perspective.

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[24] This refers to financing from developed countries (Annex I parties) to the host country, which involves a grant element of at least 25%, see http://www.cdmrulebook.org/758.

6.1 Stakeholder roles involved in the project cycle

As outlined in section 1.1.3, *The CDM Executive Board (EB)*, *Designed National Authority (DNA)* and *Designated Operational Entity (DOE)*, are the three core regulatory roles involved in the CDM project cycle. As section 1.1.3 brought up, the EB refers to one specific entity, so does the DNA of each country. Regarding DOEs, there are currently 48 approved DOEs to choose between, the majority of these are big international companies, most commonly with head-quarters in developed countries. Out of these ones 35 are approved for validation and verification of “energy industries”, which is the scope of projects that AMS 1.A belong to. In countries which host many CDM projects, such as India and Brazil, local branches from these DOEs have started to open. (List of designated national entities, n.d.; Methodologies linked to sectoral scopes, n.d.; D. Cornland, personal consultation, 27 October 2010) No Ugandan DOEs or branches have been localized.

Additional stakeholder roles involved in the CDM project development are outlined below; some which have defined meanings in the legal context of CDM, and some which are adopted in more practical fora.

CDM project participant: A CDM project participant is either “a Party to the Kyoto Protocol (i.e. a government) involved in the project, or a private entity authorized by a Party involved to participate in the project” (UNEP Risoe Center and EcoSecurities, 2007, p.53). Only project participants can receive CERs directly from the project. It is possible to add or remove participants during the project cycle.

Focal Point: The term focal point is not strictly defined since it is adopted by market practitioners but commonly refers to the entity that is responsible for the communication between project participants and the EB, and has to be mentioned as point of contact in the “modalities of communication”. The focal point is also in charge of deciding how CERs will be distributed. This entity is often but not always a project participant. (Focal point, n.d.)

Coordinating entity: In order to coordinate activities under a programmatic CDM a coordinating entity is required. This entity is described as “a project participant authorized by all participating host country DNAs involved and identified in the modalities of communication as the entity which communicates with the Board, including on matters relating to the distribution of CERs” (EB 32, Annex 38, version 2, paragraph 4). This means that the coordinating entity is replacing the function of the focal point.

A coordinating entity could be either a public or a private entity. Coordinating entities among PoAs in the pipeline also include NGO networks and (one) research institution. A comparison between the advantages of private sector and public sector coordinating entities concludes that the latter kind tend to be better suited to work with infrastructure improvements and directly with urban and rural households. Private sector coordinating entities are instead the ones which can better deal with commercial channels. (Ranade, 2010) Quite naturally, the benefits and incentives from running a PoA is expected to be linked to whether the CDM program of activities is in line with or can create synergies with core business activities of the coordinating entity. (KF Bankengroup, 2010)

Project host: A project host can be described as “the entity providing the land, facilities or resources that are required to undertake the CDM project in the developing country location of the project” (UNEP Risoe Center and EcoSecurities, 2007, p.53) There can hence be several project hosts. In the case of health centers and SHS, project hosts include (at least) the owners of the health centers and SHS suppliers.

CDM project developer: CDM project developer is not a strictly defined term, but is commonly referring to the entity with main responsibility for driving the project through the CDM project cycle. One or several project hosts could take on this role, or it could be taken on by specialized CDM project developers. (UNEP Risoe Center and EcoSecurities, 2007, p.53)

6.1.1 Project developers and legal consultants

If a project host/ project owner does not have sufficient CDM-specific competence, this knowledge does usually need to be acquired from specialized consultants. (D. Cornland, personal consultation, 27 October 2010; KF Bankengroup, 2010) Basically all projects get some help with developing a PDD. The CDM pipeline from December includes a list of more than a thousand PDD consultants which have been contracted. The top 20 consultants have together been involved in more than 2000 projects. EcoSecurities is top one with 326 projects and is an example of a specialized project developer which helps projects through each step of the project cycle. (UNEP Risoe CDM/JI Pipeline Analysis and Database, December 1st 2010, 2010; CDM project development, n.d.) Quantity is generally an advantage in project development; if the same entity can be in charge of developing and handling several CDM projects it is more likely that the process can be streamlined. (D. Cornland, personal consultation, 27 October 2010) Streamlined processes improve the chances of reducing transaction costs.

Two Ugandan entities which work with legal services for CDM have been identified. The climate change concern (mentioned in section 1.5.2) and the Ugandan Carbon Bureau. The latter entity describes itself as the only “full-service carbon company in Uganda” and has among other things been involved in the planning of a PoA for renewable energies to be implemented in Uganda as well as other East African countries. (The Ugandan Carbon Bureau, 2010). CDM-specific competence has thus been established in Uganda, but do not seem to be all that extended.

Apart from contracting external project developers/consultancy services, it may also be possible for project hosts (in the developing country) to develop sufficient CDM-specific knowledge through CDM capacity building activities. (Experiences from these kind of activities will be brought up in section 6.2) To develop capacity for CDM among developing country stakeholders has certain advantages from a long term national perspective. If external consultants take care of every aspect of the

CDM project cycle, this entails the risk that no skills, related to e.g. project development and CDM-specific competence, remains among national institutions and companies. (D. Cornland, personal consultation, 27 October 2010)

6.1.2 Graphical overview of CDM stakeholders roles

A schematic map over the stakeholder roles of the above entities are outlined in figure 8 below. The two dotted circles indicates that these stakeholder roles are of a practical kind; not enforced and regulated by the UNFCCC legal framework as being the case with other ones.

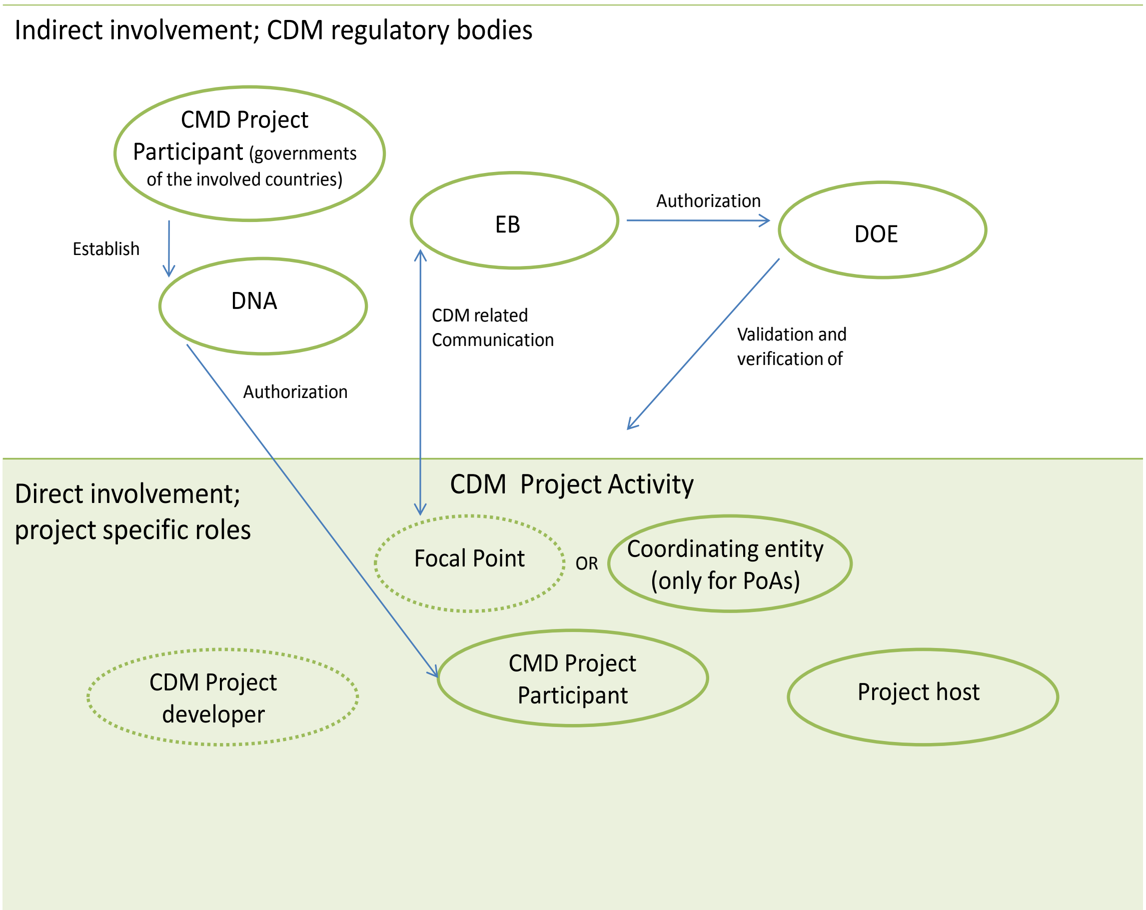

Figure 8: Overview of CDM stakeholder roles. (Source: own compilation)

6.2 Experiences from CDM capacity development in Eastern Africa

There have been several bilateral and multilateral capacity development programs which have aimed to enhance the involvement in CDM for developing countries with no or few registered projects. From an Annex I country perspective, bilateral programs are often separated from these countries CDM purchase program. Some Annex I countries do however closely link capacity development activities to purchase programs. (B. Boström, CDM Seminar, 19 November 2010)

The Swedish Energy Agency, in cooperation with Sida, was involved in a capacity development program in eastern Africa (where Sida functioned as the financer while the Swedish Energy Agency had the operational responsibility). (Capacity building, 2010-11-01, Swedish Energy Agency) This program, which ended in 2009, involved Kenya, Tanzania and Uganda. The request to be part of the program came from these developing countries. Kallhauge was one of them actively involved in the program from the Swedish side. She describes how they worked with ministries and different institutional organizations, such as banks, to develop their capacity to work with CDM. A lot of resources were also spent to work directly with project owners. (A. Kallhauge, personal communication, 20 October 2010).

Activities of the capacity program included awareness raising of CDM, screening of potential project ideas and help with performing steps involved in the different phases of the CDM project cycle. According to Cornland, who also worked directly with program participants, a lot of time had to be spent on discussing business models. Although many participants were holding high positions, there were few which had an understanding for what it takes for a project to be bankable. (D. Cornland, CDM seminar, 19 November 2010) Project development skills as such, separately from CDM, were thus a common challenge. In a few cases, these activities led to the registration of CDM projects. The main purpose of the capacity development program was however to make as many program participants as possible to go through as many steps of project cycle as possible, rather than focusing on registering a certain amount of project. The further through the CDM project cycle program participants were able to go, the more capacity they had generally acquired. (D. Cornland, CDM seminar, 19 November 2010)

The program is overall described as a successful way to work with capacity development (D. Cornland, A. Kallhauge, F. Dayo, B. Boström, CDM seminar, 19 November 2010). This was particularly true for Tanzania and Kenya, where most time were spent. The outcome of the program was less positive in the Uganda case. Kallhauge describes how she experienced a lack of patience in Uganda, which made it hard to follow up and complete capacity development activities. (A. Kallhauge, personal consultation, 20 October 2010) A general conclusion from the program was also that physical presence in the countries where the mentoring activities were carried out was (and is) crucial to its success. Physical presence helps to avoid conflicts due to local politics and to build trusting relationships. (D. Cornland, CDM seminar, 19 November 2010) Although these matters may be important for mentoring and project development in general, they were particularly emphasized in the east African context.

6.3 Financial models

6.3.1 ERPA and PDA

Two structures for CDM development, which defines the relationship between the project owner in the host country and the CER buyer/foreign investor, are the Emission Reductions Purchase Agreement (ERPA) respectively the Project Development Agreement (PDA). (UNEP Risoe Center and EcoSecurities, 2007; Curnow, 2009b) The ERPA model includes less involvement of foreign investors that the PDA model. Paul Curnow (2009b) has outlined two versions of ERPA and PDA models; the *ERPA offtake* respectively *ERPA developer model*, and the *PDA carbon-only* respectively *PDA carbon and non-carbon model*. The degree of foreign involvement increases gradually in the same order as these models are mentioned. Simplified representations of the most basic versions of the ERPA respectively PDA model are sketched by figure 9 below.

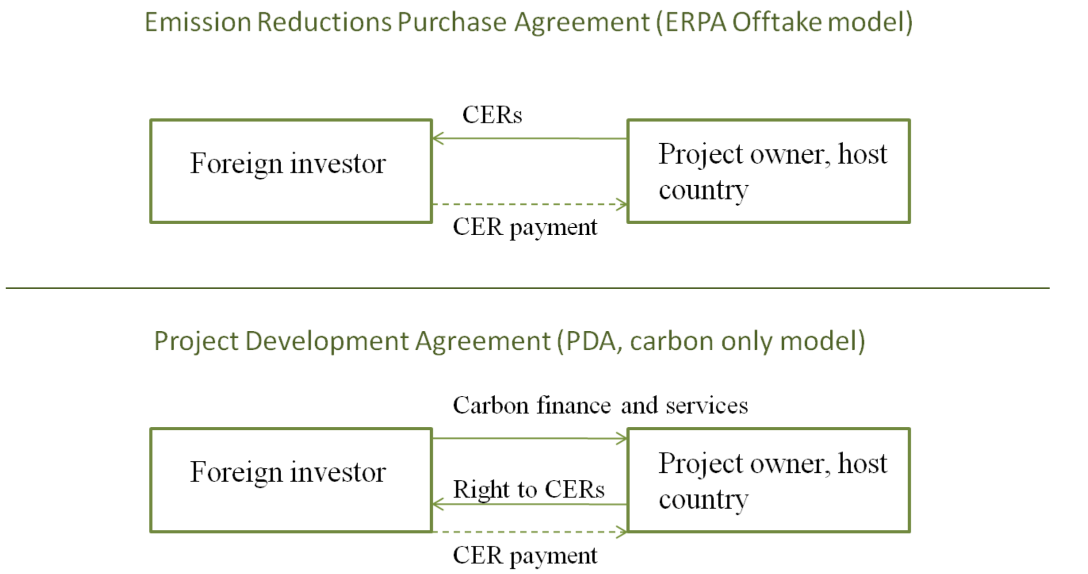

Figure 9: Difference between ERPA and PDA models. (Source: own compilation, simplified version of models outlined by Curnow Paul (2009b))

In the ERPA offtake model, the foreign investor is not involved at all in the development of the CDM project. The interaction is simply related to the sale of CERs. CER payment is likely to be made against delivery (issued CERs). In the PDA case, carbon only refers to that the foreign investor is involved with developing the CDM (carbon) component of the project, not the overall business model of the project, e.g. sales of electricity. Being involved in the development means that the foreign investor most likely will assist in upfront payments and take on some of the risks associated with the project development. The arrow marked as “right to CERs” implicates that the foreign investor commercializes the CERs on behalf of the project owner. Revenue streams from CER sales will be split between foreign investor and project owner according to contract agreements. The ERPA developer model includes a transfer of carbon services but not finances. (Curnow, 2009b)

The purposes of outlining these models have not been to mark a distinctive and definite division between different models of project development but rather to enhance the understanding for possible development options. Major CDM developers, such as EcoSecurities do engage in ERPA contracts as well as offering to commercialize the carbon credits. (Sourcing of CDM carbon credits, n.d.)

6.3.2 Carbon funds

There are a several carbon funds of multilateral as governmental and private sector origin. Many of these offer some kind of support for project cycle documentation (e.g. Prototype Carbon Fund (PCF), Community Development Carbon Fund, Spanish Carbon Fund and Netherlands CDM Facility) This support is often arranged as up-front payment of project documentation, which is later regulated against CER revenues (UNEP Risoe Center and EcoSecurities, 2007, pp.89-92)

The World Bank is the organization which administrates most of the multilateral engagements. The involvement in CDM related activities started out in year 2000, when the PCF - the first global carbon fund – was established. At this date, 2010, the Bank has 2,5 Billion USD in capitalized funds. 16 governments and 66 firms have invested money in these funds. (Carbon Finance at the World Bank, 2010, pp.1-2) The large investments which have been made in these funds is a natural explanation to the World Banks frequent involvement in CDM projects (D. Cornland, personal communication, 27 October 2010)

To try out a multitude of investment models, which the World Bank has done, has been highlighted as a positive thing for developing countries since it enables flexibility in finding appropriate financial models for local context. (F. Dayo, CDM Seminar, 19 November 2010)

6.4 Financial and Organizational structure of previous projects

A review of the PDD case studies conveys that both programmatic CDM projects include involvement of the World Bank. The Ugandan PoA is enabled through a loan from the World Bank, which is also a project participant. The Carbon Finance Unit of the World Bank will support the project with setting up the system and providing technical know-how, and will be the partner which receives the right to buy CERs. The coordination entity of the Uganda PoA is the NEMA. (Uganda Municipal Waste Compost Program, CDM-SSC-PoA-DD)

The financing of the SHS program is arranged through soft loans and grants which are provided by the Infrastructure Development Company Limited (IDCOL) to various participating organizations. IDCOL does in turn depend on the involvement of the World Bank. The International Bank for Reconstruction and Development

(IBRD), as a trustee of the Community Development Carbon Fund, [25] is one of the project participants on the PoA level. IDCOL has signed an ERPA agreement with IBRD. Grameen Shakti. (Installation of Solar Home Systems in Bangladesh, CDM-SSC-PoA-DD; IDCOL signs Emission Reductions Purchase Agreement with the World Bank, 2008-02-14) IDCOL has also received loans from IDA.

In 2009 the World Bank pronounced an additional financial loan for rural electrification and renewable energy development to Bangladesh of 130 million US$, of which around 92 millions are intended for SHS programs related to IDCOLs program. (World Bank, 2009b) Of interest to notice is also that IDCOL received GEF grants (with IBRD as a trustee) in 2002 for the same kind of program, although smaller in scope, expected to be carried out until 2007. (GEF trust fund agreement, 2002)

The coordinating entity for the SHS program of activities in Bangladesh is the solar company Grameen Shakti. (Installation of Solar Home Systems in Bangladesh, CDM-SSC-PoA-DD)

6.5 Project cycle challenges

The existence of challenges for climate mitigating project in developing countries is one of the reasons behind why CDM was introduced; as a mechanism to overcome barriers for implementation. To make use of CDM does on the other hand introduce new challenges. As section included in 6.1 and 6.2 has outlined, CDM projects can be developed in several different ways. In either way, it requires that CDM-specific skills are localized in addition to ordinary project development skills, as well as the finances to cover up-front transaction costs. The following sections will further elaborate on project cycles challenges.

6.5.1 CDM finances in relation to underlying project finance

CDM does only provide some of the finances for a project, which means that most of the finances must be arranged through other channels. Pedersen estimates that CER revenue does usually stand for less than 10 percentage of the total underlying finance for a project (Pedersen, 2009). To secure underlying finance for a project has been described as a common catch-22. (Ambrosi, 2010) Many investors are only willing to invest in projects which have already secured the underlying finance, and project owners may not be able to secure it prior to ensuring that additional finances from CER revenue can be achieved. UNDP (2006) also addresses problems with securing underlying finance as a common barrier for development of CDM projects. Cornland refers to this issue as a more or less always apparent barrier for the projects she has encountered. (D. Cornland, CDM seminar, 19 November 2010)

[25] IBRD is the second of the World Bank’s two development institutions. The Community Development Carbon Fund is one of the World Bank coordinated carbon funds and supports projects that combine: “community development attributes with emission reduction” (Retrieved 2010-10-14 from http://wbcarbonfinance.org/Router.cfm?Page=Funds&ItemID=24670)

6.5.2 Registration risk and project cycle delays

Of all projects that are initially considered as CDM projects there are many that never make it. The World Bank concluded that out of 1000 project ideas received from the beginning of the decade, only half were accepted and continued to be developed. Out of these ones, only half remains active in the CDM pipeline. (Carbon Finance at the World Bank, 2010)

The total average time in the project cycle, from the initial communication in the validation process, to complete registration is 482 days. From initial comments to issuance of CER the average time is 934 days. (*UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010*, 2010, table 12) Compared to previous years, it is especially the registration process which has been prolonged. The average registration time was pending between fifty and a hundred days in mid-2005, but had reached about two-hundred days in the beginning of 2010 (*UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010*, 2010, graph 5).

Apart from a slow registration process, some of the reasons why the project cycle may be delayed include the case where the DNA of the host country isn't sufficiently functioning (D. Cornland, personal consultation, 27 October 2010), or that the contracted DOE is suspended by the EB and thereby unauthorized in their role as an independent auditor Suspension of major DOEs have occurred a few times. Reauthorization took about three months in two of these cases. (Ambrosi et al, 2010, p.15)

6.5.2.1 PDD case study input

A review of the PDDs of the identified solar PV projects covey that the D. light Rural Lighting Project has adopted three PDD versions, and has a project cycle of a more than a year between the adoption of the first version to the registration of the project. The REDS project has gone through four PDD versions, the first completed in 2007 and the fourth in 2009. The process from the initial PDD to a complete registration is over two years. The Moroccan project has used an older PDD format, with no indication of version numbers. Two documents are however possible to trace from the unfccc.int web portal. These PDDs indicate that the process from initial PDD completion to successful registration in 2006 took at least one year. The Bangladesh SHS project is as mentioned not yet registered.

6.5.3 Performance risk

Figures from 2006 show that projects seldom receive the expected revenues. The average actual issuance of CERs represented around 50 % of the revenue expected in registered PDDs. (UNEP Risoe Center and EcoSecurities, 2007, p.84) The only solar project which has had CERs issued at this date, has an even lower issuance success rate at 18 % (*UNEP Risoe CDM/JI Pipeline Analysis and Database, November 1st 2010*, 2010)

6.6 Implications for the Ugandan context

In the case of the ICT4MPOWER project, current project partners do not really have any CDM-specific competences. Makerere University does have individuals with experiences related to CDM development (see section 1.5.2). These are however not connected to the focal project at this date. Being a large and prestigious university may be a strength in order to connect legal and technological competence to project. If a CDM project were to be linked to ICT4MPOWER, or a similar project carried out by these stakeholders, the most likely scenario would still be that CDM specific knowledge needed to be localized through external consultants. The flexibility of the CDM framework in relation to project participants, would make it possible for partners of the "non-carbon" project to chose whether to also be participants of a related CDM-project or not.

From a national perspective, Uganda does also have limited CDM-specific competence, although some service providers have been established in the country (see section 6.1.1). This point to that local (national) services may be sufficient to use. Given the small CDM industry in Uganda it may however also be the case that a project developer from the international carbon market, or a larger organization with CDM-development experience would be needed for the development process. To be part of a future capacity building program, such as that carried out by the Swedish Energy Agency outlined in 7.2, might be another potential way to obtain sufficient CDM-specific competence and getting help to start up a project. This could also be cost reducing in the sense that no or less money had to be spent directly on project documentation; it would however still require investments in time and effort (and internal salaries).

From findings in chapter 4, it seems as though REA is the national stakeholder whose core business mostly align with the scope a CDM project (related to SHS electrification of health centers). REA could therefore be seen as a potential coordinating entity in a PoA scenario.

Regarding financial arrangements and sources of investment, it is clear that the same kind of multilateral organizations are involved in CDM as well as traditional development projects (see sections, 6.3.2, 6.3.2, 6.4). As section 6.4 conveys, development institutions under the World Bank have been provided funding to the renewable energy development in Bangladesh, and the same kind of activities, when arranged as CDM as well as prior to this. In the current Ugandan context, grant money from the GEF stands for about the same proportion of the total loan for renewable energy activities under the ERT program as do (often) CDM revenues in relation to overall investments (see sections 6.3.2 and 6.5.1).

7 Transaction costs and break-even estimates

7.1 Transaction costs

General CDM-specific costs which have been identified include the following components;

> *Planning phase;* project idea note and/or feasibility study, PDD, validation, registration fee
> *Construction phase;* setup of monitoring method/equipment
> *Operation phase*; initial verification, ongoing verifications, extra cost attached to monitoring/verifying, (UN adaption fund fee, registration fee, taxes on CERs – see Ugandan exceptions)

For programmatic CDM, the introduction of each new CPA can be seen as part of the planning phase. The work associated with including a new CPA does however tend to get reduced with an increasing number of CPAs.

7.1.1.1 One-time costs and yearly (periodic) costs

Costs during the planning and construction phase, as well as initial verification are one-time costs, while ongoing-verification cost and monitoring related costs are periodic (since on-going verification is a periodic activity). There are no restrictions regarding the precise verification period but annual verification can be considered to be the common case. (UNDP, 2006, p.39) Yearly verifications being the common case is also what Möllersten has experienced. He also notes that some larger scale project have a verification period of three months while smaller scale projects may want to use longer verification periods. (K. Möllersten, personal communication, 9 September 2010)

7.1.1.2 Ugandan exceptions

CDM projects do generally have to pay so called "share of proceeds" related to the amount of emission reductions that are generated by the project activity. The registration fee (related to the administration share of proceeds) and the UN adaptation fund fee (adaption share of proceeds) are such fees[26]. As a least developed country Uganda is exempted from paying any share of proceeds. (EB 54, Annex 29, paragraph 4; 3/CMP.1, paragraph 1) It is also quite common that countries apply different types of taxes on CERs. (Curnow et. al [ed], 2009, p.79) No findings suggest that Uganda should have such taxes, why this has been ignored.

7.1.2 Transaction costs for small scale projects

One-time costs

Raab suggests that a reasonable cost estimation for PDD creation is 50 000 €, and about 30 000 € for the validation process. (U. Raab, personal consultation, 13

[26] A registration fee is an up-front payment of the administration share of proceeds, which is later adjusted towards actual CER issuance..

September 2010)[27] The EB has estimated transaction costs specifically related to countries which host few CDM projects. A new loan scheme to cover development costs for countries with fewer than 10 registered projects was suggested earlier this year (2010), since high development costs have been identified as a significant barrier to CDM project activities in these countries. According to their estimations, the cost to develop a PDD is minimum 50 000 US$ (≈38 000 €)[28] reaching up to 100 000 US$ in countries which lack an own industry for PDD consultancy. EB estimations of the cost for validation are in a price range of around 30 000 €, as estimated by Raab.[29] An initial verification is estimated to cost between 20 000 – 25 000 US$. (EB 54, Annex 10, pp.4-5)

The EB does not specify if the costs refer to small or large scale projects, why it can be assumed that both categories are included in the estimates. In general, small scale projects bring about lower costs than large scale project (UNEP Risoe Center and EcoSecurities, 2007, pp. 55-56)[30]. Costs related to performing a feasibility study and/or project idea note (PIN) can be expected to add another 5000 - 10 000 US$ to development costs. (Pedersen 2009; UNEP Risoe Center and EcoSecurities, 2007)

Additional costs attached to setup of a monitoring structure are rarely estimated, and are not included in any of the above sources. One reason for this might be that it is hard to find statistical material on this, since it may be handled by project participants rather than external consultancy firms. Another reason might be that these costs are considered to be part of the project costs regardless of if it were arranged as a CDM activity or not. A monitoring system is not a natural necessity for off-grid SHS, why costs related to this component could be regarded as transaction costs. An estimation of these costs related to a PoA scenario will be covered in the next section.

7.1.2.1 On-going costs

Figures from UNEP Risoe Center and EcoSecurities (2007, p.55) suggest that costs for ongoing verification are slightly lower than those related to the initial verification. If EB costs for initial verification are adjusted it may be expected that ongoing verification costs are between 10 000 and 20 000 US$. On-going costs for monitoring have been estimated to reach 5000 – 10 000 US$. (UNDP, 2006, p.61)
The assumptions which have been used for upfront and on-going costs are summarized in table 2, section 7.2.2

[27] Assuming that 1 euro = 10 Skr.
[28] 1 US dollar did equal 0,75 euro in average during the last year (01-12-2009 – 01-12-2010) according to OANDA statistics. This value has been used to compare rates in general. http://www.oanda.com/lang/sv/currency/historical-rates.
[29] 25 000 – 50 000 $
[30] The estimates included in the UNEP Risoe Center and EcoSecurities publication from 2007 are significantly lower than those presented by Ulrika Raab and the EB estimates. These figures have been considered less likely since they refer to CDM project in general (also China and India and countries with large CDM industry) and are from 2007 instead of 2010.

7.1.3 CDM-specific costs in the PoA scenario

Since there is still a limited amount of PoAs there are not so many sources that provide estimates on these costs. The KF Bankengroup has published a blueprint on programmatic CDM which include cost estimates and seems to be one of the more widely known.[31] (KF Bankengroup, 2010) The summarizing table of these costs are included in table 1 below.

Activity	Estimated Costs[13]	Comments
Preparation phase		
Development of PoA idea and a PIN.	Between EUR 8,000 and EUR 15,000 plus travel expenses Up to 15 days	Without feasibility studies / field visits / baseline surveys etc. Upfront
Development of PoA Design Document and CPA Design Document, including the monitoring plan.	Between EUR 30,000 and EUR 80,000, including the monitoring plan	Using a small-scale methodology which is likely in the case of PoAs Upfront
Initial Validation of the CDM-PoA-DD /CDM-CPA-DD through a DOE	Between EUR 30,000 and EUR 50,000 upfront.	Costs for subsequent CPA inclusions by DOEs are not included and mainly depend on number and complexity of eligibility criteria of the CPAs.
Implementation concept.	Up to EUR 100,000	Incl. record keeping system for each CPA, adaptation of internal procedures, documentation etc.
Registration fee, UNFCCC[14].	Registration costs of a PoA are determined by the first CPA.	Calculation of the amount to be paid and the procedures for payment will follow the existing rules for the payment of a registration fee (annex 35 to EB 23 Report).
Operational phase		
Monitoring reports. Installation of monitoring equipment and establishment of a monitoring database.	EUR 30,000 – EUR 100,000	Upfront and yearly expenses depending on the project type and applied methodology
Ongoing verification	Approx. EUR 15,000 – EUR 40,000	Depending on number of CPAs for which monitoring needs to be verified
Issuance fee, UNFCCC.	USD 0.10 for the first 15,000 t CO_2e; USD 0.20 for any amount in excess of 15,000 t CO_2e in a given calendar year	

Table 1: Estimated PoA cost (Source: KF Bankengroup, 2010, p.32)

These PoA costs are not estimated specifically for LDCs/countries with few CDM projects. It has however been assumed that international consultancy service will be

[31] The World Bank's web page on programmatic CDM documentation links to this page. It was also the source I was referred to via Angela Kallhauge.

needed in most cases why the estimates ought to be somewhat comparable to those outlined for small scale projects in the above section. (KF Bankengroup, 2010, p.32) The cost item "issuance fee" refers to the same cost as the administration share of proceeds, and is therefore not applicable to Uganda.

7.1.3.1 One-time costs

The cost estimates for PIN and PDD creation, and validation, outlined in table 1, are quite similar to those made for regular projects included in the previous section. The DOE costs for validation of additional CPAs are, as mentioned, not included and will therefore add to the development costs. The table do also include a cost item called "implementation concept", which brings up the total development costs significantly. No cost of initial verification is included in table 1. A reason for this is probably that the concept of initial verification does not really apply to a program of activities since actual project activities are added one by one after the establishment of the PoA.

7.1.3.2 On-going costs and costs related to monitoring

Ongoing verification costs seem to be about twice those for a single CDM project activity. The total size of the PoA is, as mentioned in table 1, related to these costs. The estimation of monitoring costs does not distinguish between yearly expenses and upfront cost. Neither is it specified what crediting period the total sum refers to. If it is assumed that about half of the monitoring costs are up-front and the crediting period is 7 years, this would imply that 15 000 – 50 000 € were up-front and just over 2000 – 7000 € were annual costs (which would make annual costs similar to those of regular CDM projects).

7.2 Break even scenarios

7.2.1 Assumptions for own estimates

The factors that have been taken into account for the break-even analysis are summarized by figure 10, below.

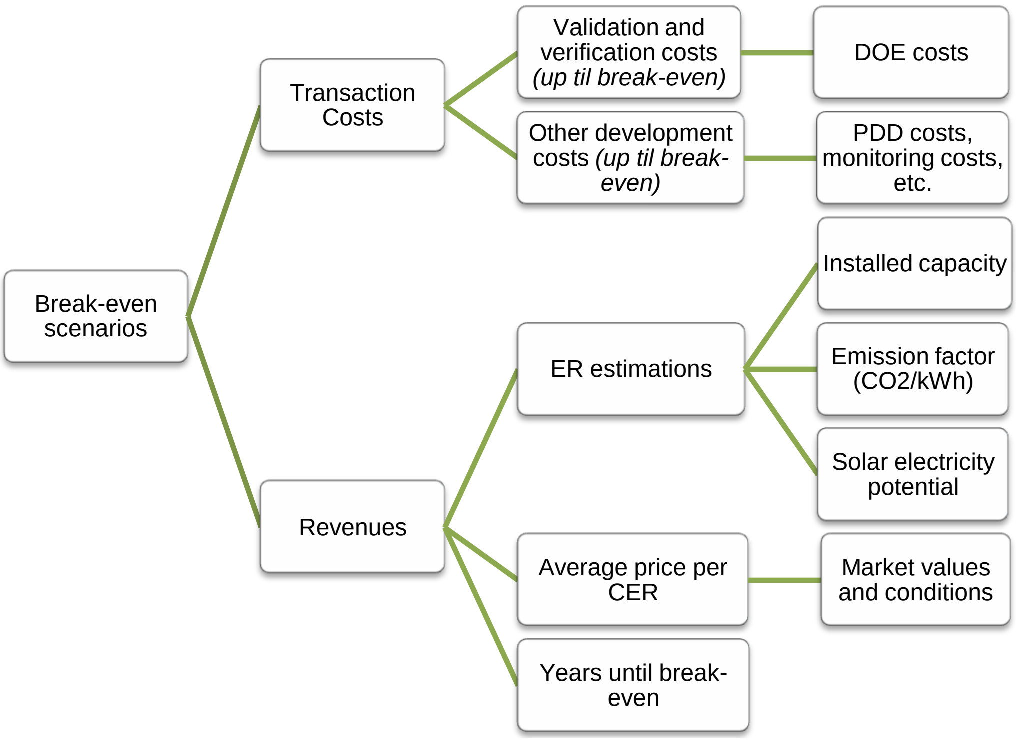

Figure 10: Model for break-even scenario for SHS, using AMS 1.A, calculation option 2. (Source: own compilation)

Although all of these factors can vary, break-even scenarios have only included installed capacity as an independent variable. Break-even scenarios have been calculated for a small scale project (less than 5 MW) and for a PoA. These calculations are made 1 and 7 years from implementation. The time for when break-even must be achieved will depend on the investor. The 7 years timeframe is chosen to represent some sort of minimum limit, in terms of installed capacity. Given the market uncertainties (see section 5.3) and common crediting periods, it isn't likely that there would be any incentives to invest in a project that did not go break-even after 7 years (which is the shortest full crediting period).

The cost assumptions included in the break-even calculations are based on consideration in the previous sections of chapter 8, and are summarized by table 2, below. A cost item called “ongoing administrative costs” has been added to represent internal costs for being involved in the CDM project cycle. No precise estimations have been found for this. It has primarily been included to point out that some ongoing additional costs exist. All ongoing costs have been assumed to add up on a yearly basis. In the PoA scenario, each CPA is expected to be 1 MW, and adding 10 000 € to the development per additional MW of the total project size. In the calculations, this cost has been added incrementally with an increased MW capacity.

For the small scale scenario, development costs have been assumed to be slightly lower than those discussed in section 7.1.2. The reason for this is that the analysis scope for PDD creation and validation is reduced due to the simplified additionality criteria. Since the adjustments for <5 MW project are made very recently no empirical evidence to support this have been found. That the complexity of the eligibility criteria affects development cost is however expected by most sources, e.g. KF Bankengroup (see table 1, section 8.1.2)

Small scale <5MW		**PoA**	
Feasibility study	5 500 EUR	Feasibility study	15 000 EUR
PDD	40 000 EUR	PDD	60 000 EUR
Validation	20 000 EUR	Validation	40 000 EUR
Monitoring preparations	30 000 EUR	Implementation concept	100 000 EUR
Initial verification	17 000 EUR	Monitoring preparations	50 000 EUR
		Validation cost per CPA	(10 000 EUR)
One-time costs	112 500 EUR	**One-time costs**	265 000 EUR
			(+ #CPAs*10 000)
Ongoing verification	11 000 EUR	Ongoing verification	25 000 EUR
Ongoing administrative costs (e.g. monitoring)	2 000 EUR	Ongoing administrative costs (e.g. monitoring)	10 000 EUR
ongoing (yearly) costs	13 000 EUR	**ongoing (yearly) costs**	35 000 EUR

Table 2: Cost assumptions made for break-even analysis

The assumptions made regarding PoA costs are uncertain, partly because there are few fully developed PoAs and partly because only one source which estimates these costs have been used. Experience of small scale project development costs (not with reduced additionality though) are more extended, these estimations are still also to be considered approximate. The preliminary purpose with the estimations is to get a better overview of how project size affects costs and revenues.

The revenue perspectives are calculated by option 2, using assumptions outlined in section 6.3.2, where 1 MW of installed capacity corresponds to 1500 CERs/year. A CER price of 9,4 €/tCO_2 have been used. This represents 80 % of the current CER prices on BlueNext and ECX, as outlined in section 5.2, which represents a reasonable estimation of the CER price if settled for a non-fully developed project at this date. The CER price is in this case expected to be the same for the whole crediting period.

7.2.2 Results from calculation

Calculations of a break-even scenario one year from the implementation show that development costs are still higher than potential CER revenue. In the small scale scenario, revenues from a 5 MW project reaches a little over 70 000 €, i.e. 55 000 € less than the transaction costs. No break-even scenario can hence be reached for this time period. In the PoA scenario, revenues corresponding to about 18,8 MW would be required in order to reach break-even after one year.

The break-even scenario 7 years from implementation is shown by figures 11 and 12.

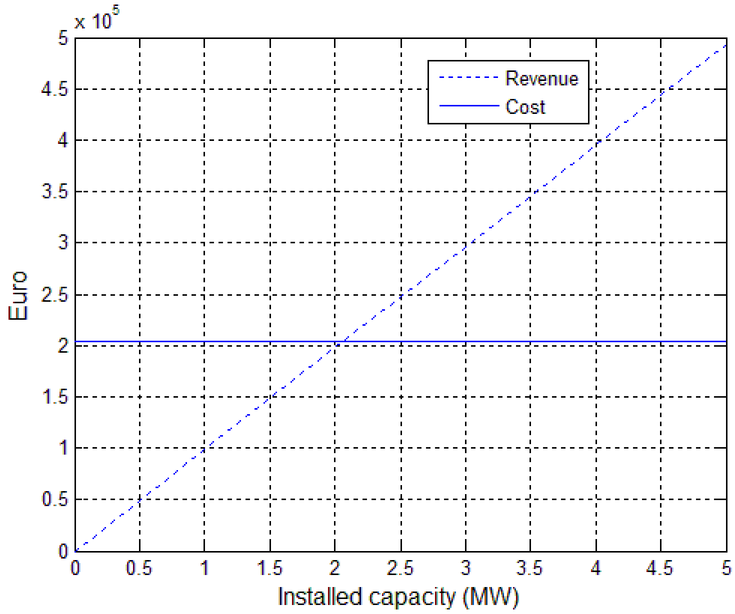

*Figure 11: Estimated break-even point for a small scale <5MW project, 7 years from implementation. (The "cost" line equals 112 500 + 13 000*7 +0*MW and the "revenue" line equals 9,4*1500*7*MW)*

What Figure 11 shows is that a project would generate slightly below 100 000 € per installed MW during a 7 year period. Since the revenue is calculated in the same way for small scale and PoA projects, this applies to both cases. For a small scale project, the break-even point is found at a little over 2 MW (2,06). This means that projects of this size and lower wouldn't bring in more revenue than its development and ongoing costs if not continued after 7 years (under made assumptions).

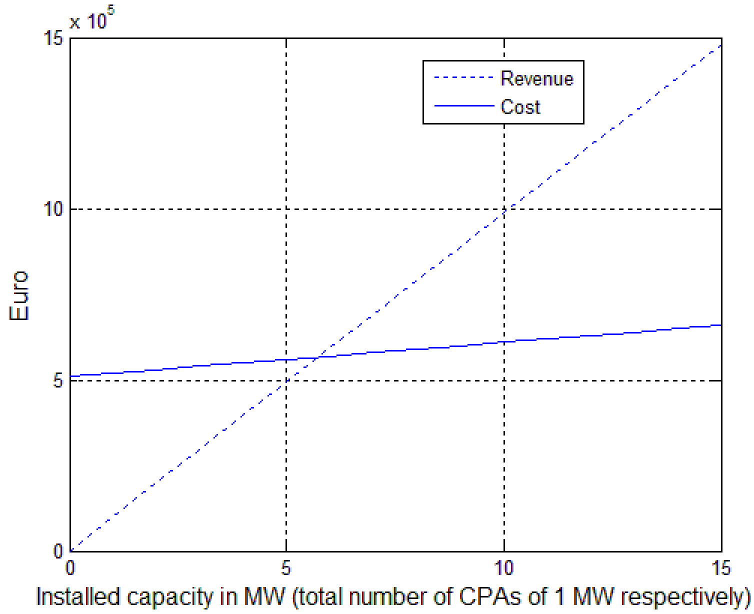

*Figure 12: Estimated break-even point for a program of activities, 7 years from implementation. (The "cost" line equals 265 000 + 35 000*7 + 10 000*MW and the "revenue" line equals 9,4*1500*7*MW)*

Figure 12 shows a break-even point around 5,75 MW, i.e. significantly higher than the small scale scenario presented by figure 11.

These results further strengthen the initial conclusion outlined in section 6.4.2, that the scope of the ICT4MPOWER is far too small to benefit from CDM. It does also seem as if a project of national coverage is too small. Results and implications are further discusses in Chapter 8.

8 Summarizing discussion and conclusions

8.1General considerations on the feasibility for CDM

8.1.1 Many uncertainties which affect the feasibility potential

The uncertainties which are connected to the development of a CDM project are many. The development of the legal framework is uncertain, partly with regard to the delayed agreements on post-2012 issues, and partly to continuous updates of project eligibility criteria. The recently adopted simplified rules for additionality demonstration (for <5MW projects) may be an indication of that the stiffness of the CDM regulatory framework are about to open up for more flexibly interpretations. This is however still only speculations. The appearance of the future legal framework affect the market situation and demand for carbon credits, and potentially also specific details for how a project can calculate baselines and establish additionality. The current project cycle is already complex. It is clear from past experiences, e.g. the many versions of PDDs which often have had to be developed, that the regulative framework has been difficult to interpret and correctly apply. These uncertainties are all in all affecting conclusions on legal prerequisites, which in turn affect estimations on break-even scenarios. The low CER issuance success rate, as mentioned in 6.5.3, is also an indication that projects often overestimate the outcomes of the projects.

Although the total CDM market has become relatively large over the years there is still limited experience of the type of application which this thesis is concerned with. Uganda has only hosted a few CDM projects, why national resources that affect capacity for arranging CDM are relatively undeveloped. Looking at the technology; there are only two registered projects so far which uses the AMS 1.A methodology for stand-alone solar systems specifically. These are both related to private households and not public institutions such as health centers.

8.1.2 Challenges related to value creation

8.1.2.1 Complementing energy sources – a general but problematic concern

Since Uganda has a very low energy and electricity consumption (relatively speaking), the preliminary national interest is not to replace the already existing energy sources. What Uganda needs, which is also apparent in Uganda's National Development Plan, is a significantly increased supply of energy, including electricity. The national focus regarding renewables should therefore reasonably be concerned with how to complement current energy sources. To help Uganda with *complementing* its energy supply in an environmentally sound way is then of great importance.[32]

[32] This is not the same as claiming that any renewable technology should be implemented anywhere. The affordability and quality of the renewable technology as well as the location and energy service which will be covered are of course also factors which are of great importance. Given the assumptions which were made prior to starting this thesis (see section 1.4.2), and the additional

Complementation may be problematic in relation to the general logic of CDM. It does not seem likely that the actual baseline for the larger parts of Ugandan health centers would have been diesel generating units, if no CDM project were carried out. It is however clear that the implementation of SHS in health centers are dependent of financial support. Without any involvement of NGOs, the GEF and others, there would probably be more diesel generating units in health centers, and also – many non-electrified units. To look at baselines in relation to alternative national scenarios for the energy sector, such as the argument quoted in section 4.3.2 related to the GEFs involvement in Uganda, seem like a quite realistic description of a baseline – but is not one which is currently an option in the reviewed methodology.

If it turned out that CDM only could be used when diesel generating units and kerosene lighting where *actually replaced*, the potential benefits of CDM would decrease considerably. The possibility of adopting the ideas of suppressed demand, and make use of a hypothetical baseline are hence crucial for the benefit potential of CDM.

8.1.2.2 Underlying project funding and potential project scopes

If CDM were to be added as a financing mechanism to current national programs it may help to speed up the process even more. The question is whether any Ugandan entity could afford to take on the rest of the investment needed. In the ICT4MPOWER setting, the UCC had difficulties to make any larger funding contributions, which was the very starting point of the CDM investigation carried out by this thesis project. The government receives large grants and loans to bear the costs of the national investments. The installation of SHS at health centers is at this date a generally non revenue producing activity. As mentioned in section 3.1.2, no fees are to be taken out by public health centers. Whenever this is the actual situation, the value adding element of SHS (and other investments that can improve services) is merely the long-term sustainability impact. The hopefully increased economic conditions in the districts due to improved health conditions would likely not be apparent until much later. Costs that are not financed through grants (or a potential CDM-revenue) does therefore need to be carried by someone, e.g. the districts or Ministry of Health, during a longer time-period than what would have been the case if the loans were to be repaid directly by end-customers.

Given the considerations outlined in the above paragraph, the following implications are likely; most projects (unless very small) would face barriers related to upfront costs as well as to ongoing maintenance costs (as earlier discussed). Stakeholders that may want to invest in SHS for health centers do not have an unlimited budget. Although electrification of health centers can be expected to create long-term sustainability benefits, these investments are still competing with other potential investments, which may also be expected to entail sustainability benefits. As long as the CDM-specific profit could only support a small proportion of the upfront and/or

findings of ongoing electrification schemes and policies, it is however considered that it is possible to find suitable SHS technology, and also, that the scope of energy service which is planned to be covered by the ICT4MPOWER project are comparable to the scope that would be relevant for a national scenario.

operation costs, this would improve the prerequisites so that a larger project could be arranged than what would otherwise have been the case. It would likely not push the investment threshold very far though (which might be the case for investments in almost-commercial activities, e.g. the case of the SHS project in Bangladesh)

8.2 Revisiting the research questions

8.2.1 What are crucial factors which affect the legal applicability for CDM?

The establishment of a baseline is the legal factor which has been identified to be most crucial for any arrangement of CDM in the empirical setting of this investigation. For a PoA arrangement, additionality on the PoA level is also identified as a potentially crucial factor. Although all CDM requirements that have been discussed in Chapter 6 are crucial in the sense that they need to be recognized and followed, there has not been found any evidence that these other factors couldn't be fulfilled relatively easily.

8.2.2 What are expected break-even scenarios for different types of CDM projects?

The scenarios for break-even 7 years from implementation (in previous section, 8.2.3) are those which have been considered to represent reasonable estimates in terms of minimum size of a small scale project, respectively a PoA; 2,06 MW installed capacity, corresponding to 3090 CERs annually (see section 5.4.2) for a small scale project, and for a PoA; 5,75 MW installed capacity, corresponding to 8625 CERs annually.

8.2.3 What are crucial factors which affect the value creating potential for CDM?

The amount of CDM related profit which can be generated from a project is, as already mentioned in the first chapter, an important factor. All factors which are expected to affect the break-even scenario (outlined in figure 10, section 7.2.1) are therefore import to recognize. If the market value and emission factor could both be doubled this would for example four-double the revenue potential. If it were possible to arrange a project through a capacity development project or similar and thereby get rid of some of the development costs, this would also improve the profit potential. Due to the unpromising break-even scenarios no focus has been placed on investigating the needed CDM-specific profit. What can be noted is that previously registered solar PV projects, as outlined section 5.2.1, have profit potentials far beyond any break-even scenario.

Considerations outlined in section 8.1, related to baseline applications and the availability and character of the underlying finance are also identified as crucial factors. If the underlying investment is sound, the chances that CDM will add value will increase. Since current investments include a lot of ODA (GEF money), it is of importance to take into account how a CDM arrangement may affect the availability of these finances. Non-diversion of ODA is included as one of the requirement for CDM. The usage of the mechanism ought therefore not to result in decreasing funding from those sources. Since it seems somewhat hard to ensure the conformity of this part of the legal framework, it is still identified as a crucial factor. For scenarios as the ones outlined for health centers, where CDM is relevant to look at only from a national perspective, is seems as if the function of the mechanism becomes somewhat similar to that of ODA.

To explore the difference between these funding mechanisms have not part of the investigation. Some considerations will still be outlined at this point. The monitoring requirements and verification process of CDM is one of the differences which may affect the operation of projects. Although impact analysis likely is required for most grant or loan funded projects as well, it is likely less strict than for CDM. Since real issuance of CERs only is made after the verified operation of the project there are financial incitements for ongoing operation. If transaction cost would be spent on national consultants and resources, CDM may also create economic incentives to raise national project development skills, which might be useful also outside of the CDM area. These are some of the considerations regarding why CDM as a mechanism might have a greater value potential than other financial options (provided that there was an economical potential to use the mechanism). Regarding technology transfer and related value creating opportunities, the few findings which have been covered on this topic do not point to that this would be particularly related to CDM. In terms of technological transfer, this could be arranged without the usage of CDM. Regarding know-how, sharing of risks etc, the CDM framework does create opportunities for this. These opportunities are however not dependent on the transfer of technology.

8.2.4 What scenarios would make the usage of CDM legally applicable and value creating?

Related to ICT4MPOWER:
In the case of the ICT4MPOWER project, there are no realistic scenarios for the above research question. The scope of the ICT4MPOWER project is nowhere near the scope outlined by the break-even scenario for a small-scale project, and has therefore no value creation potential. Simply ongoing costs for verification, which are more or less always the same since these are paid to DOEs, are a lot higher than annual revenues. There is therefore no motive to make use of CDM for such a small scale scenario.

A CDM project related to the ICT4MPOWER project could also hypothetically have been arranged as one part of a larger CDM project. Bundling and programmatic CDM, or a combination of these, are two alternatives which have been investigated that can join different project components together. The break-even scenarios can once again be referred to as a reason for why such scenarios are unlikely. Although the assumptions underlying these estimations were to change somewhat it is clear that the total scope of a CDM arrangement need to be made up by hundreds of constituting parts if each were in the size of the Isingiro project. Since the

ICT4MPOWER plan to start implementing the energy solution in the beginning of 2011 and it takes quite a long time to go through the CDM project cycle (e.g. requires an initial PDD to be created prior to the start of real project activity) there are no realistic prospects of establishing a broad CDM solution in time for the ICT4MPOWER project. Regardless of the practical aspect, the uncertainties related establishment of a baseline remains. It is also uncertain if it would be possible to arrange a large enough scope, although the other prerequisites would have been the right ones for the ICT4MPOWER. This question transcends to the part of the thesis scope concerned with a Ugandan national perspective.

Related to a Ugandan national perspective:
Findings in this thesis indicate that it is unlikely that the investment potential for SHS at health centers would be large enough for a CDM project to be economically feasible. The estimated investment potential of around 1 MW for health centers II-IV (as outlined in section 5.6) is only half that of the break-even scenario for a small scale CDM project, and less than one-fifth of the PoA break-even scenario.

Since all project components need to be submitted for registration jointly for a small scale project, a PoA seem like the more realistic alternative from an organizational perspective. This arrangement would however complicate the demonstration of additionality and require a larger scope to go break-even. If community health workers were to be included in a project scope it may possibly be large enough. The additional obstacles from a practical and value-creating perspective outlined in section 8.1 (as well as uncertainties about the baseline) are however additional arguments for why CDM might not be feasible. The challenges for an investment in SHS at this health center level are further increased by the large gap between the community health workers wanted, and those active, and the voluntary character of these health workers. In summation, the investigation of the national perspective has neither resulted in the identification of any realistic scenarios which would make CDM feasible. The uncertainties which are related to this conclusion are many. The revenue potential is also a lot larger than for the ICT4MPOWER scenario. If some of the prerequisites turn out be a lot more fortunate than assumed in this thesis it is therefore possible that there are feasible scenarios after all.

8.3 Conclusions in brief

A lack of economical potential is the main reason for concluding that CDM wouldn't be feasible to use in relation to the ICT4MPOWER project. This is also the main reason for concluding that CDM most likely neither would be feasible to use for a national scenario.

A combination of question marks related to practical, legal and value creating considerations, addressed in the previous sections of this chapter, are further adding to this conclusion. The investigated scenarios cannot be written off as infeasible from a legal perspective. The conclusion made in this thesis is however that the establishment of a baseline seems to become somewhat ad-hoc for the Ugandan context in relation to the current CDM methodology. Since SHS electrification already receives financial support for health center applications, the complementing function of a CDM project is somewhat uncertain. Although there would have been economical incitements from a break-even perspective, CDM might therefore still not be feasible for either of the investigated scenarios.

Due to the changing environment and the many uncertainties associated with the prerequisites for CDM, the feasibility potential from a national scenario is however hard to rule out for sure. Possibilities which have not been explored by this thesis include the usage of a cross-country approach. A cross-sector approach, e.g. health and education might be another possibility. These approaches would enable a large scope and thereby improve the chances to find a feasible application from a value creating dimension.

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10 Annex

Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories

1. Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

(Attachment A to Appendix B (of Decision 4/CMP.1, Annex II))