CD4CDM Working Paper Series
WORKING PAPER NO. 5
October 2008

CD4CDM
CAPACITY DEVELOPMENT FOR THE CLEAN DEVELOPMENT MECHANISM

Technology and knowledge transfer from Annex 1 countries to Non Annex 1 countries under the Kyoto Protocol's Clean Development Mechanism (CDM) -An empirical case study of CDM projects implemented in Malaysia

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UNEP RISØ CENTRE
ENERGY, CLIMATE AND SUSTAINABLE DEVELOPMENT

Technology and knowledge transfer from Annex 1 countries to Non Annex 1 countries under the Kyoto Protocol's Clean Development Mechanism (CDM)

– An empirical case study of CDM projects implemented in Malaysia


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Abstract

The CDM constitute a central element in political discussions on climate change concerning means to facilitate transfer of technology and knowledge, regarding greenhouse gas (GHG) mitigation technologies, from Annex 1 countries to Non Annex 1 countries. The purpose of this thesis is therefore to answer the question of what role the CDM plays in relation to transfer of technology and knowledge. The thesis relies on multiple sources of qualitative data and is conducted as a multiple case study of thirteen CDM projects implemented in Malaysia. It focuses on the companies involved in implementation of specific technologies in these projects and the channels that can facilitate the transfer process. The aim of the thesis is therefore to provide insights into the dynamics of technology transfer at the micro–level. An analytical framework is put forward based on which it can be concluded that the CDM only plays a role in one out of the thirteen projects examined. The thesis may contribute to provide a background on which future provisions concerning technology transfer in the CDM, and/or other mechanisms that involve GHG mitigation activities in Non Annex 1 countries.

Keywords: *The Kyoto Protocol, Clean Development Mechanism, technology transfer, firm–level technological capabilities, Malaysia.*

Resume

CDM udgør et centralt element i politiske diskussioner omkring klimaforandringer og de foranstaltninger, der kan facilitere overførsel af teknologi og viden, i relation til drivhusgas reduktions teknologier, fra Annex 1 lande til ikke Annex 1 lande. Formålet med dette speciale er derfor, at besvare spørgsmålet om hvilken rolle CDM spiller i forhold til overførsel af teknologi og viden. Specialet hviler på forskellige typer af kvalitative data og er udført som en multipel case undersøgelse af tretten CDM projekter implementeret i Malaysia. Der fokuseres i specialet på virksomheder, som har været involveret i at implementere de projektrelaterede teknologier og de kanaler, der kan facilitere overførselsprocessen. Specialet forsøger derved at frembringe indsigt i de dynamikker, der udspiller sig på mikroniveau omkring teknologioverførsel. På baggrund af specialets analytiske forståelsesramme, kan det konkluderes, at CDM kun spiller en rolle for teknologi og vidensoverføsel i ét CDM projekt. Dette speciale kan bidrage til at danne baggrund for at beslutte fremtidige bestemmelser i relation til teknologioverførsel i CDM og/eller i andre mekanismer, der involverer drivhusgas reduktions aktiviteter i ikke Annex 1 lande.

Keywords: *Kyoto protokollen, Clean Development Mechanism, teknologioverførsel, teknologisk kompetence på virksomhedsniveau, Malaysia.*

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Abbreviations

AAU's	Assigned Amount Units
AGBM	Ad hoc Group on the Berlin Mandate
AIJ	Activities Implemented Jointly
CDM	Clean Development Mechanism
CER's	Certified Emission Reductions
COP	Conference of the Parties to the Climate Change Convention
CTI	Climate Technology Initiative
DANCED	Danish Cooperation for Environment and Development Programme
DNA	Designated National Authority
DOE	Designated Operational Entity
EFB's	Empty Fruit Bunches
EGTT	Expert Group on Technology Transfer
ERU's	Emission Reduction Units
EST	Environmentally Sound Technology
FDI	Foreign Direct Investment
GEF	Global Environment Facility
GHG	Greenhouse Gas
GWP	Global Warming Potential
G77	Group of 77
IPCC	International Panel on Climate Change
IPO	Initial Public Offering
IPR's	Intellectual Property Rights
JI	Joint Implementation
LCMB	Lafarge Malayan Cement Berhad
MOP	Meeting of the Parties to the Kyoto protocol
MW	Megawatt
NCCDM	National Malaysian Committee on the CDM
NGO	Non Governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
SBSTA	Subsidiary Body for Scientific and Technological Advice
TTClear	Technology Information Clearing House
UNFCCC	United Nations Framework Convention on Climate Change

Contents

1. Introduction

1.1. Technology transfer in the UNFCCC and the CDM

Within the last decades there has been growing evidence that human activity is changing the atmospheric composition of greenhouse gasses (GHG's) primarily due to the burning of fossil fuels (IPCC, 2007). The concern is that this can cause dangerous climatic changes that can have adverse effects for both human and biological systems. In 1992, this concern led to the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) (UNFCCC, 1992). The ultimate objective of the convention is therefore to prevent dangerous anthropogenic interference with the climate system. An important part of achieving this objective requires technological innovation and rapid transfer and widespread implementation of technologies, including know–how for mitigation of GHG's (Metz et al., 2000). The subject of technology transfer was also emphasised as an important element of the UNFCCC, where all parties according to article 4.1 were required to:

]..”*Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gasses*..”[(UNFCCC, 1992;5).

In article 4.5 of the convention, it was furthermore accentuated that:

]..“*The developed country Parties and other developed Parties included in Annex 1I shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties*..”[(UNFCCC, 1992;8).

The industrialised country parties to the convention (the Annex 1 countries) thereby accepted a specific obligation and responsibility to facilitate technology transfer to the developing country parties (the Non Annex 1 countries)[1]. Underpinning the developed countries' commitment in this matter, was the acknowledgement in the convention of the limited historic responsibility of developing countries to the causes of, and the consequently need for the developed countries to take the lead action in combating; climate changes[2] (Müller et al., 2007). Article 4.5 above also reflects that the transfer of technologies under the convention was recognised as a means to, and a process whereby, the technological competences of the developing country parties should be augmented. In this regard, the transfer of technology and knowledge, regarding GHG–mitigation technologies, was understood as an essential element to enable and support the

[1] See http://unfccc.int/ (2007a) for a list of Annex 1 country and Non Annex 1 country parties to the UNFCCC.
[2] This acknowledgement is encompassed in the central notion of common but differentiated responsibilities, which is a key principle of the UNFCCC framework (UNFCCC, 2006a).

developing countries, in the longer term, to establish a path of development with low GHG–emissions (see also UN, 1992, Wilkins, 2002, Forsyth, 2007).

Although the transfer of environmentally sound technologies (EST's) could play a pivotal role in mitigating climate change it has also been a contested issue in negotiations concerning international politics of climate change (Paterson, 1996, Forsyth, 2003, Kallhauge et al., 2005). The disagreement has especially been due to the diverging interests between the developing countries and the developed countries in these negotiations (Gupta, 1997, Lütken, 2005, Olsen, 2007, Prum, 2007). The developing country parties have in this regard, continuously pursued that their active involvement, including eventual binding obligations under the UNFCCCC–regime, should be conditional on, inter alia, provisions of technology and knowledge transfer from the developed country parties (Paterson, 1996, Gupta, 1997, Chasek, et al., 2006, Robert & Parks, 2006).

Since the adoption of the convention the subject of technology transfer has on many occasions, within the UNFCCC–domain, been discussed both at the Conference of Parties (COP) and meetings of the Subsidiary Body for Scientific and Technological Advice (SBSTA) (Metz et al., 2000, UNFCCC, 2006a). This has given rise to the initiation of several forums and implementation frameworks, among these the Expert Group on Technology Transfer (EGTT) and the Technology Information Clearing House (TTClear), which focuses on upscaling and enhancing technology transfer under the convention.

In 1997, the Kyoto protocol was adopted as a supplement to the UNFCCC with the primary purpose to implement legally binding GHG–emission reduction targets for the developed country parties to comply with in the period 2008–2012 (UNFCCC, 1998). As a mean for the Annex 1 countries to fulfil their commitments in a cost efficient manner, the so called flexible mechanisms were introduced in the protocol. The Clean Development Mechanism (CDM), which is one of these mechanisms, will be the central focus of this thesis. In short, the CDM is a market based trading mechanism, which allows the Annex 1 countries to implement projects that reduce GHG–emissions in Non Annex 1 countries. The CDM therefore constitutes an important element in the context of facilitating transfer of technology and knowledge to the developing country parties (Forsyth, 2003, UN, 2003). The Kyoto protocol established in this regard, in article 10.c, that all parties to the protocol were required to:

]..”*Cooperate in the promotion of effective modalities for the development, application and diffusion of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies, know–how, practices and processes pertinent to climate change, in particular to developing countries*”..[(UNFCCC, 1998;10).

It was moreover specifically reiterated, and further emphasised, in the Marrakech accords, which account for the detailed modalities and procedures of the CDM, that the:

]..”*Clean development mechanism project activities should lead to the transfer of environmentally safe and sound technology and know–how in addition to that required under Article 4, paragraph 5, of the Convention and Article 10 of the Kyoto Protocol*.”] (UNFCCC, 2002;20).

What the above decisions reflect is on the one hand that the institutional and judicial framework conditions of the Kyoto protocol does not include a formal mandatory or legally binding requirement, for the developed country parties to ensure technology transfer under the CDM. On the other hand, it also mirrors the central role that the CDM has played in the political deliberations, both within and outside the UNFCCC–domain, concerning the intentions of the CDM regarding possible means to facilitate the transfer of technology and knowledge to the developing country parties (Metz et al., 2000, Sprintz & Luterbacher 2001, Lütken, 2005, Lütken & Michaelowa, 2008). This was not least evident during the initial negotiations and proposals concerning the configuration of the CDM, where a strong connection was made, especially by the developing country parties, between the CDM and its role in channeling technology transfer (Gupta, 1997, Grubb et al., 1999, Richards, 2001, Philibert, 2003). Officially available information from the UNFCCC system has also featured similar descriptions regarding the objectives of the flexible mechanisms and the CDM, in that:

“*These mechanisms help identify lowest–cost opportunities for reducing emissions and attract private sector participation in emission reduction efforts. Developing nations benefit in terms of technology transfer and investment brought about through collaboration with industrialized nations under the CDM*.” (http://unfccc.int/, 2007b)[3].

These political intentions are echoed in a number of the CDM project investment purchasing programmes of the Annex 1 countries’ governments, among these the Danish (http://www.danishcarbon.dk/, 2008) and the Canadian (http://www.international.gc.ca/, 2008). Lastly, the subject of technology transfer has increasingly become a central topic in the political discussions concerning a new international institutional and regulatory climate change regime after 2012, which is the expiry date of the Kyoto protocol. This was not least evident at the UN climate change conference held in Bali in 2007, where issues related to reaching a final decision, in Copenhagen in 2009[4], concerning the design of a future regime was discussed (UNFCCC, 2008). Effective mechanisms that can facilitate and scale up the deployment, diffusion, and transfer of technologies to developing country parties and the development of performance indicators to evaluate these aspects were key issues at the Bali conference. In relation hereto, the negotiations concerning a future climate agreement may in general be influenced by the previous experiences of the Kyoto protocols flexible mechanisms and the CDM in particular (Clémençon, 2008). Studies addressing technology transfer as this currently is occurring in the CDM, may therefore prepare the foundation for decisions concerning the design and provisions of future mechanisms. It is unclear however, what role the CDM will play

[3] See also Nordqvist (2005) or UN (2007).
[4] This meeting is referred to as the COP 15, which refers to the fifteenth Conference of the Parties to the UNFCCC.

in a post 2012 regime, although it seems likely that a similar yet modified mechanism will continue in some form.

1.2. The focus and objective of this thesis

In the academic litterature, a limited number of studies have specifically addresssed technology and knowledge transfer in the CDM. The studies conducted thus far are primarily based on an assessment of the claims concerning technology transfer made in the official CDM project design descriptions (PDD's). Moreover, these studies mainly focus on the technological hardware aspects, i.e. whether technological components or installations have been transferred in CDM projects[5]. On this background, there is a need for additional studies aiming to understand in further detail, and through fieldstudies, the nature and substance of technology transfer and how these processess are taking place in concrete CDM projects. This involves to take into consideration the knowledge related aspects of technology transfer and in this regard also study the experiences of the relevant actors involved. It is therefore the intention with this thesis to undertake an assessement, and thereby contribute to a greater understanding, of technology and knowledge transfer from Annex 1 country parties to Non Annex 1 country parties under the CDM, by including the above elements.

In order to specify this overall research topic, this thesis is undertaken as a qualitative case study of the registrered CDM projects implemented in Malaysia. By opting for a specific Non Annex 1 country, the intention is to reduce the interest sphere of this thesis, in order to conduct a more intensive and in–depth study of the technology transfer processes in the CDM. This differs from the more extensive methods applied in the previous studies, which included various types of projects implemented in numerous countries, sectors, and industries. Secondly, Malaysia has as a central element of its institutional CDM approval system formulated detailed conditions concerning that CDM projects should facilitate technology and knowledge transfer. It could therefore be expected that this element would be an important part of the implemented projects, which render Malaysia suitable as a case for studying the associated processes. Thirdly, in Malaysia, and in the South East Asian region, the number of CDM–projects have been increasing and are expected to continue to increase (UNEP, 2008a). Therefore, a resonably large amount of implemented projects exist in Malaysia that can be studied. In addition, the insights obtained from studying these projects can be valuable in relation to considerations of the arrangements and configurations of similar projects in the future. Lastly, the Malaysian CDM projects have a limited variation in relation to their project types and the types of technological systems implemented. Along with focusing on one country, this contributes to minimise the variables that could influence the processes associated with the transfer of technology and knowledge in the projects. This makes Malaysian CDM projects useful to study as a case in order to focus more on the complex relations and interactions between the relevant technology transferee and transferor actors (the receivers and providers of technology) as weel as the channels that can facilitate the transfer process.

[5] In chapter 4, a more comprehensive account of the studies previously conducted on technology transfer under the CDM will be provided.

The above leads to state the following main research question of this thesis:

What role do CDM projects play in relation to the transfer of greenhouse gas mitigation technologies from Annex 1 countries to Malaysia?

As a central and further demarcation issue, it needs to be stressed that the level of analysis will be confined to address the relevant companies involved in the implementation of the technologies in the specific CDM projects. As technologies are predominantly owned by companies and typically diffuse through markets, in which companies are key actors, this makes this level of analysis relevant to focus on (Wilkins, 2002). It is therefore the intention to concentrate to a lesser extent on the macro–level framework conditions influencing technology transfer in the CDM, including political and economic structures, legal framework conditions, etc., in the Malaysian, the Annex 1 country, and the international context. However, the institutional and regulatory framework of the Kyoto protocol, which the companies under the CDM operate within, needs to be taken into consideration.

In order to answer the main question of this thesis, the following research sub–questions will be addressed:

- What companies are involved in the CDM projects, which can be identified as the respective Malaysian transferee and Annex 1 country transferor companies and what kind of relationships are evident between these companies?
- Does the CDM in this regard establish new channels of technology and knowledge transfer between these companies?
- Does the CDM facilitate transfer of technological hardware components from Annex 1 country companies to Malaysia?
- How have the Malaysian based transferee companies developed concerning their core business activities, project involvement, and more, prior and subsequent to their participation in CDM projects?
- In this regard, does the CDM enhance the technological capabilities of the transferee companies, which enable or improve the ability of these companies to handle, implement, develop, etc., the technologies pertinent to the specific CDM projects?

1.3. Structure of thesis

In table 1 below, the structure of this thesis is provided. It displays the central elements contained in the different chapters of the thesis.

Table 1. Structure of thesis.

Chapter 2	In this chapter, the basic features of the Kyoto protocol and its flexible mechanisms will be addressed and will owing to the specific interest sphere of this thesis, focus on the CDM. The chapter also serve to examine the regulatory system under the CDM and to introduce some of the concepts, within the CDM system, that are frequently used throughout this thesis.
Chapter 3	This chapter will present the research design and the methods that will be applied in this thesis to answer the main research question. The chapter will present and discuss the procedures related to collection and analysis of relevant data and thoroughly account for the methodological considerations in this regard.
Chapter 4	Following this, the fourth chapter will review the studies that specifically have been concerned with the subject of technology transfer in the CDM. Furthemore, the chapter will present and define the focal concepts and notions that constitute the central elements of the analytical framework, which will be applied in the analytical process of this thesis.
Chapter 5	This chapter will present the analytic results that have been obtained from the data taken into consideration in this thesis.
Chapter 6	The analytic results in chapter five will be discussed in chapter six first through a case–by–case – and subsequenlty in a summary discussion.
Chapter 7 & 8	Lastly, the conclusions drawn in this thesis will be presented in chapter seven and chapter eight will place the thesis within a larger climate change policy related context.

2. The Kyoto protocol and the CDM system

This chapter describes some of the basic features of the Kyoto protocol and its flexible mechanisms and particularly focuses on the CDM. The chapter also serves to introduce some of the concepts frequently used in this thesis. First, a general introduction to the Kyoto protocol is provided, which is followed by a short description of the history of the CDM. The subsequent section presents the specific provisions and modalities of the regulatory system relating to the implementation procedure of CDM projects.

2.1. The Kyoto protocol and the flexible mechanisms

The Kyoto protocol was adopted in 1997 at the third conference of the parties to the UNFCCC (COP 3) in the Japanese city Kyoto. It marked a new paradigm in international climate change politics by implementing legally binding GHG–reduction commitments for the Annex 1 country parties to the convention (UNEP, 2004, Chasek, et al., 2006). The ground for negotiating and ultimately adopting quantitative emission targets in the Kyoto protocol had previously been laid out in the so–called Berlin mandate at the COP 1 meeting in 1995 within the ad hoc group on the Berlin mandate (AGBM), which later became the Kyoto protocol (Grubb, et al., 1999, Lütken & Michaelowa, 2008). The Annex 1 countries that have subsequently ratified the protocol have thereby jointly committed themselves to reduce their aggregate GHG emissions by at least 5 % below 1990 levels in the period 2008–2012 (the first commitment period) (UNFCCC, 1998). On the 16th of February 2005, the protocol entered legally into force after the russian ratification in 2004 ensured that at least 55 parties to the convention, including the Annex 1 country parties whose total GHG emission level represented 55% of the 1990 industrial countries emissions, had ratified the protocol (http://unfccc.int/, 2008a).

The Kyoto protocol, in its central provision, defines allowable GHG emissions, equivalent to reduction commitments, for each Annex 1 country party to the protocol in terms of assigned amount units (AAU's) for the commitment period (Grubb et al., 1999). The aggregate reduction commitment, defined as percentages relative to base year emissions, was furthermore internally differentiated among the parties, and set out in Annex B of the protocol (UNFCCC, 1998, Fenger, 2000). The commitments cover emissions of six greenhouse gases from identified sources, which together account for the majority of the GHG emissions of the industrialised world (Grubb et al., 1999). These comprise carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF_6). In the protocol, these gases are converted into CO_2–equivalents and thereby compared on the basis of their respetive 100 year global warming potential (GWP) (IPCC, 2001).

As a central element, the Kyoto protocol introduced three flexible market based mechanisms in order for the Annex 1 countries to meet their reduction targets in a cost efficient manner (Perman et al., 2003, Halsnæs & Olhoff, 2005, http://unfccc.int/, 2008b). In table 2 below, a short description of these mechanisms is provided.

Table 1. The flexible mechanisms under the Kyoto protocol.

Emission trading	Parties with commitments under the Kyoto protocol (Annex 1 countries) have accepted targets, expressed as AAU's, for limiting or reducing GHG emissions. Emissions trading, as set out in Article 17 of the Kyoto protocol, allows Annex 1 countries that have surplus emission units to spare – owing to various reasons – to sell this excess capacity to countries that are over their commitment targets.
Joint Implementation (JI)	This project–based mechanism was defined in Article 6 of the Kyoto protocol. JI allows an Annex 1 country to earn emission reduction units (ERU's), each equivalent to one ton of CO_2 emissions, from an emission reduction project in another Annex 1 country, which can be counted towards meeting the Kyoto targets of the Annex 1 countries.
Clean Development Mechanism (CDM)	As defined in article 12 of the Kyoto protocol, the CDM allows an Annex 1 country to implement emission reduction projects in Non Annex 1 countries, which under the Kyoto protocol do not have emission reduction targets. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one ton of CO_2 emissions, which can be counted towards meeting the commitment targets of an Annex 1 country.

Source: Forsyth (2003), UNFCCC (1998).

As can be seen from the above, the Kyoto protocol introduced two project–based flexible mechanims; Joint Implementation and the Clean Development Mechanism, which both involve the implementation of an emission reduction project in either an Annex 1 country or, in the case of the CDM, a Non Annex 1 country. The rationale underlying this market based approach concerns that the impact of GHG reductions on climate change mitigation is not sensitive to the origin of the reductions[1]. Therefore, there is a rationale of economic flexibility in achieving emission reductions in geographical locations, which offer the lowest costs per unit of GHG emission reduction (Grubb et al., 1999). The Kyoto protocol therefore allows the Annex 1 countries flexibility in complying with their commitments by offering the possibility to utilise these mechanisms as a supplement to domestic emission reduction efforts (UNFCCC, 1998). The emission reductions created and traded as a consequence of the flexible mechanisms constitute, or comprise, the international market of tradable carbon emission permits under the Kyoto protocol regime (Halsnæs & Olhoff, 2005). The emission reduction units generated from JI and CDM projects (ERU and CER credits) represent, as AAU's, one metric ton of (tradable) CO_2–equivalents and these can therefore be internalised in the Annex 1 countries' internal GHG emissions accounts. The Annex 1 countries can, as well as private sector entities, decide to obtain ERU's and CER's either through investing in own JI and CDM projects or these can be bought from project developers or brokers on the carbon market[2] (Amin, 2005). It needs to be mentioned that the new commodity market of CO_2 emission

[1] This is attributable to that green house gasses dissolve and disperse effectively in the atmosphere. The origin of the emissions are therefore not important in relation to their contribution to climate change (Grubb et al., 1999, Amin, 2005).

[2] A comprehensive compliance and registry system to keep account of the national and international transfer of AUU's, ERU's, CER's, etc., have therefore been set up internationally and in the respective countries.

allowances and credits under the Kyoto protocol emission regime also has been integrated in the EU ETS emission trading system (http://eur-lex.europa.eu/, 2008).

While the first Kyoto commitment timeframe concerns the period 2008–2012, it has been allowed to implement both JI and CDM projects from before this period and in this way generate ERU's and CER's, which can be saved or traded on the market[3] (Amin, 2005). Since the first CDM project was registered in 2004, the growth of the CDM project market has been expanding rapidly (Point Carbon, 2007, Capoor & Ambrosi, 2008). Currently, the total registered CDM projects amount to over 1100 projects, which are expected to generate over 1.5 billion CER's, or 1.5 million tons of CO_2 emission reductions, until the end of 2012 (UNEP, 2008a). Furthermore, there are over 3900 CDM projects in the pipeline, which include for the most part, projects presently at validation[4]. The countries attracting the majority of CDM projects include China, India, Brazil, and to a lesser extent Mexico and Malaysia. In Malaysia, the interest in and investments in CDM projects has especially been growing within the last two years and there are currently over 130 projects in the pipeline (Ibid.).

2.2. Short history of the CDM

The period from the COP 1 meeting in Berlin to the approval of the Kyoto protocol at COP 3 was a cumbersome and intense negotiation process in which a variety of facts, ideas, perspectives, interest, and positions ultimately needed to be balanced in the final text of the protocol (Grubb et al., 1999). During the later stages of the negotiation process, both within and outside the AGBM forum, the pressure grew from the Annex 1 countries to adopt provisions for flexibility mechanisms to comply with their reduction targets under the protocol (Lütken, 2005). A key issue for the Non Annex countries was to implement a regulatory penalty system to secure that the Annex 1 countries would comply with their emission reduction commitments. A Brazilian proposal was in this regard put forward, inter alia suggesting a clean development fund, which was to be replenished through financial penalties paid by Annex 1 countries not in compliance with their reduction commitments under the protocol (Richards, 2001, Lütken & Michaelowa, 2008). The fund was furthermore meant to channel these financial means to Non Annex 1 country parties, with the purpose to invest in GHG emission mitigation and possibly climate change adaptation measures as well as activities in their respective countries (Grubb et al., 1999). Therefore, a pivotal element of this proposal concerned a possibility to channel transfer of technology and investments into the developing countries (Gupta, 1997, Richards, 2001). However, it seems that the clean development fund during the concluding negotiations, was changed from a 'line of compliance' proposal to encompass such investments as contributing to compliance for the Annex 1 countries, rather than being a penalty for non–compliance (Grubb et al., 1999, Richards, 2001). The idea of a penalty system was thus changed from a fund to an investment mechanism for the Annex 1 country parties to undertake GHG mitigation activities in the Non Annex 1 countries. The fund had thereby moved away from its previous character and into what later became the CDM, although most developing country parties did not discover this alteration

[3] In the case of the CDM, the crediting period may be counted back to year 2000 (Amin, 2005).
[4] See Appendix 1 for an overview of the CDM project pipeline.

during the negotiations and therefore still expected the CDM to have the characteristics of the fund proposal (Richards, 2001, Olsen, 2007, Lütken & Michaelowa, 2008). The basic features of the clean development fund, concerning the nature of GHG mitigation project activities, as initially proposed, would however remain encompassed in the CDM.

2.3. The regulatory system under the CDM executive board

When the text of the Kyoto protocol was finally decided upon, the purpose of the CDM was contained in article 12 as:

] ..”*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 and reduction commitments under Article 3.*”] (UNFCCC, 1998;11).

As can be seen from the above, the CDM require the Annex 1 countries to assist Non Annex 1 countries in achieving sustainable development in addition to its function as an emission reduction compliance mechanism for the Annex 1 country parties. Furthermore, a central issue in the Kyoto protocol is that emission reductions accruing from project activities under the CDM are to be certified by third party operational entities on the basis of specific criteria’s, including voluntary participation, real, measurable and long term benefits related to mitigating climate change, and emissions additionality[5] (UNFCCC, 1998). The CDM executive board was established to supervise these principles and the operation of the CDM under the authority and guidance of the conference of the parties of the UNFCCC serving as the meeting of the parties to the Kyoto protocol (COP/MOP[6]) (UNFCCC, 2005a). While the protocol identified a number of modalities to assist the Annex 1 country parties reach their emission targets, it did not elaborate on the specific issues related hereto (UNEP, 2004). It was first at the 2001 COP 7 meeting in Marrakech that the concrete details concerning the management regime of the CDM was negotiated and decided upon in the so–called Marrakech accords[7] (UNFCCC, 2002). These accords laid the ground principles, rules, modalities, and procedures on which the COP/MOP and accordingly the CDM executive board subsequently have structured the governance and guidance issues related to the CDM (Dessai & Schipper, 2002, Chasek, et al., 2006). The following will go through the basic characteristics of the present rule and regulation system pertaining to the implementation of CDM projects.

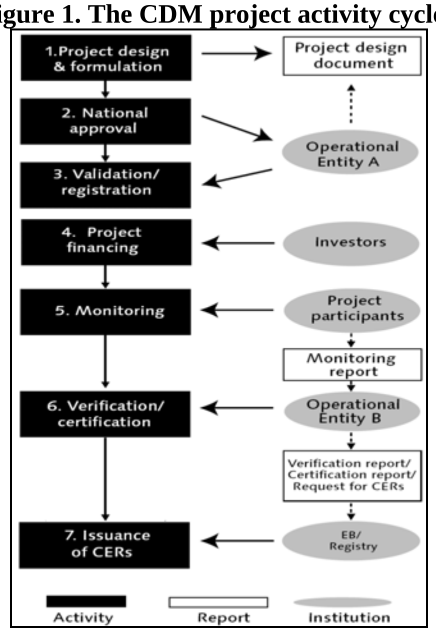
[5] It appears that the guiding principles of the CDM were inspired by the experiences from the initial activities implemented jointly (AIJ) projects, which were commenced at COP 1 (Grubb et al., 1999).
[6] The conference of the parties to the UNFCCC (COP) and the meeting of the parties to the Kyoto protocol (MOP) are together mandated to determine the legal and constitutional structure of the CDM (Amin, 2005).
[7] Which followed up on the Buenos Aires Plan of Action from COP 4 (Dessai & Schipper, 2002).

2.3.1. The CDM project activity cycle

In order for Annex 1 countries and Non Annex countries to participate in CDM projects, the Marrakech accords require these to meet three fundamental eligible criteria's (UNFCCC, 2002). These comprise their voluntary participation in the CDM, the establishment of a CDM related designated national authority (DNA) as an institutional body in the respective countries, and the countries' ratification of the Kyoto protocol (UNEP, 2004). The role of the DNA's, in the Non Annex 1 CDM project host countries, is furthermore to undertake the approval of the projects, including to ensure that the project activities conform to the sustainable development criteria's of these countries (UNDP, 2003, Amin, 2005). In this regard, it is the prerogative of the Non Annex 1 country in question to formulate and define the sustainable development criteria's used to assess CDM projects (UNFCCC, 2002). Some Non Annex 1 countries have as an element of this included requirements concerning technology transfer (Haites et al., 2006).

Under the regulatory system supervised by the CDM executive board, all CDM projects are subject to the same implementation procedure, which is known as the project activity cycle[8] (http://cdm.unfccc.int/, 2008a). A simplified presentation of this process, as shown in figure 1, is provided below, which concentrate on the aspects that are relevant to this thesis. This account addresses the sequential steps in this cycle although emphasis is laid on the preparation of PDD's, in the initial step of the CDM project cycle, and will take into consideration the key institutions, actors, and documents involved in the process.

Figure 1. The CDM project activity cycle.



Source: UNEP (2004).

[8] To ensure that the CDM executive board undertakes supervision of the CDM in this matter, a number of additional bodies have been established, including the methodology panel, the accreditation panel, various working groups, and more.

In the initial phase of the project cycle, the project proponents prepare a project design document (PDD), which in detail explains the nature of the specific project activity. As a basic requirement, the project must be eligible to be undertaken as a CDM project activity under the Kyoto protocol (UNDP, 2003, http://cdmrulebook.org/, 2008). After achieving initial approval of the project from the regulatory system of the respective DNA in the Non Annex 1 country, the PDD is submitted for validation, which is carried out by an independent designated operational entity[9] (DOE) (UNFCCC, 2005a). The DOE's are accredited by the CDM executive board to perform a third party evaluation of the PDD's. This is done on the basis of the criteria's and principles set out in article 12 of the Kyoto protocol, the Marrakech accords, and relevant COP/MOP and board decisions[10] (UNDP, 2003). The key findings from this evaluation are provided in the respective projects' validation reports, based on which the DOE's recommend approval, i.e. request for registration, or request corrections made, concerning the project activity to the executive board (UNFCCC, 2005a). In this regard, simplified modalities and procedures have been adopted for small–scale CDM projects, although the evaluation criteria's pertaining to these projects concern the same principles[11].

In the PDD's, certain key issues must be addressed and accounted for in a satisfactory manner in order to achieve validation and registration, including a description of the crediting period for the proposed project activity. This can either be a maximum of ten years or a maximum of seven years, which may be renewed at most two times. Furthermore, all CDM projects must apply a methodology, configured to the specific nature of a given project activity, which has been proven by the CDM executive board[12] (see http://cdm.unfccc.int/, 2008a). In relation to this thesis, sections A.4.2. and A.4.3. of the PDD's are particularly relevant, since project proponents must include a description of how environmentally safe and sound technology, and know–how to be used in the project, is transferred to the host country party (http://cdm.unfccc.int/, 2008b). However, the CDM executive board has not developed detailed guidance principles as to how this requirement should be demonstrated and substantiated. Project proponents are therefore allowed individually to account for this subject in the PDD's in a way they judge adequate. The PDD must also include a monitoring plan, based on an approved methodology, that address all matters related to data collection and data archiving methods, measurement parameters, etc., necessary for estimating and measuring the GHG emissions occurring within the project boundary during the crediting period (UNFCCC, 2005a).

A central element of the PDD's is to demonstrate how the anthropogenic GHG emissions by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. This concerns the principle of additionality as encompassed in the Kyoto protocol, which in concrete terms, during the preparation of a PDD, can be a complex undertaking (UNEP, 2008b). A PDD must therefore, in sections

[9] DOE's are typically commercial companies paid by the project developers to undertake the evaluation.
[10] The DOE may take supplementary information into consideration in their evaluation beside the PDD's.
[11] See UNFCCC (2002) for definitions of small–scale CDM projects within different categories.
[12] The project proponents may decide to apply an already existing methodology or to propose a new in relation to the project proposal submitted to the executive board.

B.4. and B.5, contain a thorough explanation of how and why the project activity is additional to, and therefore not identical with, the baseline emission scenario that would have occurred in the absence of the project being undertaken as a CDM project activity. It is therefore the responsibility of the DOE's to carefully assess and verify the reliability and creditability of all data, rationales, assumptions, justifications, and documentation provided by project participants to support the demonstration of additionality. The CDM executive board has in this regard provided a guidance tool that project developers can apply, as a general applicable framework, to prove the additionality of a given project. In the guidance tool, a four–step process is suggested, in which the first step involves an identification of realistic and credible alternative scenarios to the project activity (http://cdm.unfccc.int/, 2008b). This aspect is complementary to the required application of an approved emission baseline scenario methodology, which represents the anthropogenic GHG emissions that would occur in the absence of the proposed project activity (UNFCCC, 2002, http://cdm.unfccc.int/, 2008b). In relation to step two and three, project proponents may decide to use either an investment analysis or a barrier analysis and they may, if they wish to, apply both. The investment analysis, in step two, aims to demonstrate that the project activity is most likely to be the least financially attractive among the identified alternative scenarios, without the revenue from the sale of CER's (UNDP, 2003)[13]. In the alternative possibility, in step three, the intention of the barrier analysis is to describe the realistic and credible barriers that hinder project proponents to implement the proposed project activity and which, at the same time, does not exclude at least one of the alternative scenarios. The possible technological barriers, which may be taken into consideration in this regard is shown in table 3 below.

Table 3. The technological barriers that may be included in the PDD's.

– Skilled and/or properly trained labour to operate and maintain the technology is not available in the relevant geographical area, which leads to an unacceptably high risk of equipment disrepair, malfunctioning, or other underperformance.
– Lack of infrastructure for implementation and logistics for maintenance of the technology (e.g. natural gas cannot be used because of the lack of a gas transmission and distribution network).
– Risk of technological failure: The process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed CDM project activity, as demonstrated by relevant scientific literature or technology manufacturer information.
– The particular technology used in the proposed project activity is not available in the relevant geographical area.
– Lack of prevailing practice: The alternative is the "first of its kind".

Source: http://cdm.unfccc.int/ (2008b).

As can be seen, these potential project related technological barriers, may be related to technology and knowledge transfer and are therefore relevant to take into consideration in this thesis. Project proponents can in step four furthermore undertake a common practice analysis to demonstrate the extent to which the proposed project type, e.g. technology or practice, has already diffused within the relevant sector and region[14]. The objective of this analysis is to account for any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same

[13] It is therefore the purpose to present evidence for the financial barriers that prevent the proposed project from occurring, by using various economic indicators.
[14] This is a credibility check of the already performed investment or barrier analysis.

country or region and/or rely on a similar technology, are of a similar scale, and take place in a comparable environment with respect to the regulatory framework, investment climate, access to technology and financing, etc. (http://cdm.unfccc.int/, 2008b).

After achieving registration of the proposed project activity and thereby formal acceptance by the executive board, the project can be implemented. This subsequent implementation phase generally involves various key participants and stakeholders, including governmental bodies, municipalities, foundations, financial institutions, NGO's, private sector companies, including technology providers, consultants, etc., and others that implement and operate CDM projects (UNDP, 2003). In addition, public and private sector entities are moreover involved in the investment and purchase of CER's from CDM projects, which include different corporations, carbon procurement funds and programs, government bodies (from the Annex 1 country parties), NGO's, and more (Capoor & Ambrosi, 2008, UNEP, 2008a, see also www.cdmbazaar.net). A key issue in the Kyoto protocol was in relation hereto, through the flexible mechanism and especially concerning the CDM, to attract private sector participation in activities concerning the reduction of GHG emissions (Grubb et al., 1999, Lütken & Michaelowa, 2008).

After the implementation of the project activity, the relevant data from the monitoring period is included in a monitoring report, see figure 1, which is submitted for verification undertaken by an independent DOE[15]. Verification is an ex post determination of the monitored emission reductions and represent a process in which the DOE undertake detailed and periodically performed verification of the authenticity of the data collected, as per the monitoring plan. On the basis of this process, the DOE summarises its findings in a verification report (UNEP, 2004, see also www.cdmrulebook.org). Subsequently, the DOE submits a certification report to the executive board, which is a formal confirmation that the achieved emission reductions, as set out in the verification report, were actually achieved. The board may, in the final phase of the project cycle, issue CER's to the rightful owners based on verified and certified emission reductions as requested in the certification report (UNDP, 2003).

[15] In relation to large–scale CDM projects, the DOE is not allowed to be the same as DOE that has performed the validation. This is allowed in small–scale CDM projects however.

3. Research design and methods

This section describes the strategies, procedures, and methods applied to collect and analyse the data taken into consideration to answer the main question put forward in this thesis. In the following, the intention is to describe the concrete activities associated with the preparation of this thesis as explicit, detailed and clearly as possible.

3.1. Case study selection

This thesis is designed as a qualitative case study of the CDM projects registrered and implemented in Malaysia so far. As mentioned in the introductory chapter, different concrete reasons, which essentially constitute the case selection strategy applied in this thesis, led to decide on Malaysia as the Non Annex 1 country of interest (Neergaard, 2001). In relation hereto, case studies can be considered as an appropriate research strategy when an investigator wants to undertake an empirical enquiry of a contemporary phenomenon within its real–life context, especially when the boundaries between the phenomenon and context are not clearly evident (Denzin & Lincoln, 2000, Neergaard, 2001, Yin, 2003). Case studies are therefore relevant to apply in order to deepen a prior understanding of a present phenomenon, including its contextual conditions, and more, and may be especially relevant when the phenomenon under study is poorly understood (Andersen, 2003, Boolsen, 2006). A case study design was therefore considered appropriate for this thesis, as the subject of interest constituted a current phenomenon that has been inadequately described and where the (Malaysian) context, inter alia concerning the concrete companies involved, the CDM regulatory system, etc., appeared to be a central element to be included in the analysis. In this regard, it needs to be stressed that the knowledge, which can be obtained from case studies is context dependant and particularistic and the conclusions drawn cannot, in a statistical sense, be generalised to other CDM projects concerning technology and knowledge transfer (Miles & Hubermann, 1994). The findings of this thesis are therefore closely related to the Malaysian context and the specific technologies addressed[1]. In generel, case studies are characterised by representing a type of intensive research design, where a few units of study, and a greater amount of details concerning the features and properties of these units, are taken into consideration, as opposed to more extensively designed studies (Pedersen & Nielsen, 2001, Danermark et al., 2002, Andersen, 2003). Different types of case study designs have previously been suggested, including illustrative, explanatory, descriptive, explorative, and others, although they all involve an intensive and in–depth study of one or a few cases studied in their respective contexts (Yin, 2003, Boolsen, 2006).

As mentioned, it appears that a previous understanding of technology and knowledge transfer in the CDM is quite limited, especially regarding the concrete actors and processes involved. Furthermore, as will be seen in chapter 4, coherent theories

[1] However, the results of qualitative case studies may be analytically generalised. The process of analytical generalisation concern, inter alia, that previously developed theory is used as a template with which empirical results of the case study are compared (Yin, 2003). Therefore, if two or more cases are shown to support the same the same theory, replication may be claimed.

concerning technology transfer, especially within the climate change litterature, and which focuses on the company level, have not been identified. For that reason, the questions advanced in this thesis are not based on overarching theories, involving assumptions on causal relationships, and more, and the empirical observations will therefore not be placed within a pre–existing theoretical explanatory framework. Therefore, this thesis is designed as an explorative case study, owing to the lacking knowledge base and availability of litterature that provides such a framework and hypotheses of note (Danermark, et al., 2002, Yin, 2003). However, troughout the process of preparing this thesis, a variety of publications, including previous studies, and more, have been taken into account regarding the subject of technology and knowledge transfer, both in the context of climate change and others. These have been taken into consideration in order to discuss different conceptualisations and understandings of technology transfer and to develop the analytical framework applied in this thesis (presented in chapter 4), including in this regard to specify the key concepts that will be integrated in this framework. The analytical framework advanced in this thesis, on the basis of which the role of the CDM will be assessed, has been prepared to present the pre–understanding of technology and knowledge transfer as explicitly as possible (Kvale, 1997).

3.2. Methods of data collection and analysis

3.2.1. Projects and companies taken into consideration

As an initial data collection strategy and at an early stage of preparing this thesis, it was considered relevant only to take the CDM projects that had been registrered by the CDM executive board before the 1st of November 2007 into consideration[2]. By opting for registrered projects, the intention was to focus on projects that had been fully implemented, or was at a final stage of implementation, in order to study the previous project–related experiences of the relevant companies involved. Therefore, a gross list of eighteen registrered projects was at the outset identified. The idea was to concentrate on a larger group of projects, which were similar in nature and content[3], but which at the same time would be internally diversified in different ways, inter alia regarding the circumstances related to, and the companies involved in, the process of implementing the technological systems. It appeared from the PDD's pertinent to these projects that the thirteen CDM projects entailing implementation of boiler systems that primarily utilise biomass residues from the Malaysian palm oil industry fulfilled these criteria's and these were therefore selected for further consideration. The remaining five projects, involving waste water treatment (CDM project No. 867), factory energy–efficiency improvements (CDM projects No. 757 and 759), and landfill gas extraction projects (CDM projects No. 323 and 927) were therefore initially excluded.

On this basis, the subsequent strategy was to carefully read the respective projects PDD's and validation reports, in order to identify and contact the specific companies that had been involved in the technology related aspects of the biomass projects. This also

[2] The preparation of this thesis was started on the 1st of October 2007.
[3] This refers to CDM projects that have applied the same overall type of technological system.

involved to address different CDM related stakeholders in the Malaysian context, which could provide this kind of information, including the relevant Annex 1 country embassies, the Malaysian DNA, consultant companies, and more. These efforts led to a preliminary identification of the relevant Annex 1 country companies and Malaysian based companies. Subsequently, an initial round of telephone and email correspondence was undertaken with employees from these companies in order to attain a tentative or preliminary understanding of the companies' roles in the projects and to identify additional relevant companies. In this regard, it was not possible to reach the relevant employees from the companies listed in the PDD pertaining to CDM project No. 288 (see UNFCCC, 2006b). For that reason, this project was excluded from further considerations. In addition, it was considered relevant to include CDM project No. 1186, since this project was identical to the abovementioned biomass projects and at a final stage of implementation, although the project was registrered on the 21th of December 2007[4]. During this initial phase, it became increasingly evident that the internal variation in the implementation pattern and characteristics of these biomass projects, e.g. regarding the constellation of companies involved, was quite limited. Therefore, the five previously excluded projects were taken into account again, and CDM project No. 927, which from the PDD seemed to imply a different type of internal dynamic and arrangement, was considered appropriate to include as well. In summation, fourteen projects, which can be seen in Appendix 2, were considered relevant to include in this thesis. These projects each involved the participation of Annex 1 country and Malaysian based companies and a significant element of the analytic process has been to address, in further detail, the constellation of companies pertinent to the specific CDM projects. This is presented in chapter 5, but it needs to be stressed that the thesis in this regard is structured as a multiple case study, where each case denotes the constellation of companies involved in the specific CDM projects (Miles & Huberman, 1994, Yin, 2003).

3.2.2. Sources of data and key informants

This thesis relies on multiple sources of qualitative data. Of primary relevance have been the PDD's and to a lesser extent the validation reports of the specific CDM projects taken into account. These were read carefully through in order to understand the concrete technological installations implemented in the projects. More importantly, the passages in the PDD's that concern the various projects' respective formal and official claims, intentions, and objectives, regarding technology and knowledge transfer were especially examined. This was done with the purpose to assess and compare these claims with other sources of data, a method also referred to as data triangulation (Yin, 2003, Boolsen, 2006). In this regard, a central element of this thesis has involved undertaking a number of interviews with employees from the Annex 1 country and Malaysian companies involved in the identified projects. The intention was to interview company representatives from both sides of the (PDD's) proclaimed technology transfer process, in order to understand their individual companies' history and development, internal relationship, and concrete interaction throughout their CDM project involvement[5]. The

[4] Personal communication (email and telephone) with Mr. Johan Collins and Mr. Vincent Weyne from the company Vyncke Energitechniek N.V. during the period between November and December 2007.
[5] This may be referred to as informant triangulation (Miles & Huberman, 1994).

strategy was therefore to conduct interviews with key employees from these companies that posses thorough and detailed knowledge regarding their respective companies' interaction and involvement both historically and in relation to the concrete CDM projects. Therefore, the key informants identified have primarily been in higher and longerstanding management positions within the various companies, which enable these to provide such information. It was therefore considered that these employees were able to account for the company and its activities as a whole, which, although valuable for this thesis, also imply limitations to an understanding of the individual employees in the companies[6] (Miles & Huberman, 1994, Andersen, 2003). It also needs to be mentioned here that an opportunity arised during the field study period in Malaysia to undertake interviews with employees from the Malaysian CDM project approval system. This is accounted for in chapter 5.

During the initial round of email and telephone correspondence, arrangements were made with the relevant employees in order to undertake these interviews. The key informant interviews were conducted both as telephone interviews and undertaken in relation to personal meetings at the companies' head offices in Malaysia. The interviews with the relevant employees from the companies in Malaysia were performed in the period from the 3rd of March to April the 13th 2008, which represent the fieldstudy period of this thesis. These visits therefore also involved a possibility to collect company specific information, including presentation and profile description papers of the companies, which also constitute a central element of the data material in this thesis. Furthermore, this fieldstudy in Malaysia also made it possible to visit a number of the relevant CDM projects on site and therefore to undertake concrete observations. The fieldstudy concentrated on companies and projects located in the area around Kuala Lumpur and the southern region of peninsula Malaysia around the city of Johor Bahru. In this regard, the fieldstudy also facilitated discussions with a number of different persons in Malaysia related to implementation of CDM projects, which were not interviewed, but which provided valuable background information[7]. Other sources of information regarding the respective companies have been obtained in particular from the Internet websites of the companies and other relevant websites. It must be emphasised however that information originating from the companies themselves need to be cautiously examined since these typically have been prepared to portray a given company in a certain self promoting way.

3.2.3. Interviews and reliability of interview data

The companies involved in technology related aspects of CDM projects can be seen as one of the key private sector actors in the CDM and possible facilitators of technology transfer, since they for a large part own the various technological systems implemented in specific projects. The interviews undertaken in relation to this thesis are therefore expected to provide an increased understanding of how the concrete activities of these

[6] The interviews with the key informants may therefore be said to provide information on a more aggregated level concerning the company in question.
[7] Of particular importance in this regard was a meeting arranged with the (Malaysian) chairman of the expert group on technology transfer (EGTT) under the UNFCCC, Mr. Kok Kee Chow, for a discussion of CDM and technology transfer.

key actors, regarding the specific CDM projects, relate to or have implications for technology and knowledge transfer. On this basis, these interviews, as one method of qualitative data collection, constitute a central part of the data material that underlie the analysis undertaken in this thesis. As a fundamental condition concerning interviews, it is necessary to be aware that the interviewer interprets and understands, on the basis of given implicit or explicit pre–understandings, the interpretations and opinions of the interviewee, regarding the subject matter. This circumstance in relation to interviews can be described as a double hermeneutic process where the interviewer seeks to attain knowledge of an already interpreted reality or situation (Kvale, 1997, Hansen & Simonsen, 2004, Boolsen, 2006). In continuation, and in relation to the informants taken into consideration in this thesis, it was the intention to gain insights into and understand, how the CDM in generel, and as a mechanism of technology transfer, was regarded and percieved from the point of view of the involved companies' employees (on behalf of the respective companies). However, it was not the purpose to uphold the positivistic ideal of an objective and neutral interviewer and the interview may therefore, more appropriately, be referred to as a mutually negotiated text co–authored by the interviewer (Kvale, 1997, Denzin & Lincoln, 2000). All interviews performed in relation to this thesis, which in total comprise 16 interviews, have been recorded on a digital dictaphone and these are appendend in Appendix 3 as mp3 sound files on a DVD. The key findings from these interviews, which are presented in chapter 5, can therefore be ascertained here.

Prior to the interviews, a short description of the objective of the thesis, the reason for taken the specific company into consideration, and the topics that would be addressed during the interview was sent to the respective informants. This was done in order to have a common frame of reference and to openly state the purpose of the interview, in relation to the objective of the thesis, to avoid or reduce mistrust, which could distort the interview (Miles & Huberman, 1994). In addition, a comprehensive interview guide was prepared previous to each interview, which intended to operationalise the key factors from the anaytical framework[8] (Kvale, 1997). In the introduction of chapter 5, it will be described how the questions and themes in these interview gudies have been structured. Although the interviews were performed as semi–structured, the interview guide was followed quite stringent, in order to enable the subsequent interpretation and coding process, especially regarding the Malaysian informants, to be undertaken based on the analytical framework (Miles & Huberman, 1994, Kvale, 1997, Andersen, 2003, Boolsen, 2006). However, it was considered important not to be locked entirely in the coding framework beforehand and therefore also be open for new aspects and dimensions relating to the subject matter that emerged during the interview (Kvale, 1997, Denzin & Lincoln, 2000). With the aim of preventing biased answers from the informants, the interview questions were strived not to be formulated as leading questions but as questions with different options of answer. The interviews were primarily undertaken in English, which imply a possibility for misconceptions, confusion, unclarities, etc., since this is not my first language and rarely the first language of the informants involved[9]. However, since all the interviewed informants held high positions in companies with

[8] These documents will be appendend in relation to the specific cases examined in chapter 5.
[9] Three interviews were undertaken in Danish and these interviews have not been translated but are also appended in Appendix 3.

international relations and activities, they were accustomed to formulate themselves in English. Notwithstanding this, it was considered essential to ask the informants to repeat or clarify an answer if any doubt occurred concerning the meaning of specific terms and phrases used in order to ensure an accurate understanding of the answers (Kvale, 1997). This was especially relevant in relation to the technical descriptions and expressions, concerning the different technological systems in question, used by the informants of whom the majority were engineers by training. On the other hand, it was also imperative that the informants understood the intentions and content of the interview questions put forward during the interview. Furthermore, different problems can be associated with conducting interviews with persons in leading positions, owing to their inclination and ability to control the interview, their tendency to portray, through strong argumention, the area under discussion in a certain light, etc. (Miles & Huberman, 1994, Kvale, 1997, Andersen, 2003). These problems were strived to be reduced by being well prepared both in terms of company and informant specific information and in relation to the CDM related aspects, by maintaining the inititive throughout the interview, by formulating clear and easy understandable questions, and more (Andersen, 2003). Among other factors, which in general can influence the interaction between the interviewer and the informant in the interview situation include different culturel understandings, power relations, age, sex, etc. It was therefore the intention to be aware of these aspects and what influence this would have on the interview. As a central bias issue, there was the possibility that the informants from the Malaysian companies would portray matters relating to technology and knowedge transfer in a certain way, since this was an official priority for the CDM approval system of the Malaysian DNA. Therefore, it was necessary prior to the interview to state the non–political and purely academic interest in conducting an interview with the respective informant. In this regard, if considered necessary, the informants were informed that an official research permission from the Malaysian economic planning unit (see www.epu.jpm.my) had been obtained to conduct a study in Malaysia, which contained various liability issues, in order facilitate an open discussion[10]. In generel however, it was considered that the informants would have limited interests in deliberately distorting their statements in the interviews. Yet it was also expected that the informants' willingness to share information during the interview would be limited by their awareness to avoid revealing vital trade secrets of the respective companies in relation to the different technologies.

3.2.4. Coding of interviews

As mentioned above, the data taken into consideration in this thesis, to assess the role of technology and knowledge transfer in the CDM, will be analysed on the basis of the analytical framework presented in chapther 4. Furthermore, this framework has been applied to guide formulation of the interview questions and has specifically, in relation to the interviews performed with the Malaysian the informants, been used as pre–determined coding categories in the analytic proceess regarding these interviews (Kvale, 1997). The coding process regarding interviews with the Malaysian informants has been undertaken based on an identical matrix for each interview in order to systematise the data and to depict the findings from these interviews as explicit and transparent as

[10] See http://www.epu.jpm.my/ (2008) for the stringent research approval procedure.

possible (Miles & Huberman, 1994, Boolsen, 2006). These interviews have not been transcribed and it was considered that the coding and analysis could be done directly on the basis of repeated and meticulous listening to the recorded interviews. In this regard, a matrix system has been developed for this coding and interpretation proces, which can be seen in table 4 below, in which the key factors from the analytical framework constitute the first column. The second column refers to the passages and statements that during the interview specifically concerned the subcategories within the respective factors. The time reference examples given in the second column, which refer to the concrete sequences in the recorded interviews, are therefore directly linked to the interpretation of these passages in column three. Therefore, column three demonstrates the process of condensation the meaning of the specific passages in the interviews (Kvale, 1997). A guiding principle in the interpretative procedure has been to include all data that fell within a given sub categorical boundary. The fourth column represents a further concentration of the interpretations in the third column and depicts the analytic sub–results that will be included in the complete analysis regarding the case in question in chapter 5.

Table 4. The coding matrix regarding the interviews with Malaysian informants.

<table>
<tr><th>Factors in the analytical/ interpretive framework and subcategories within these</th><th>Explicit statements or passages in the interview concerning this issue</th><th>Interpretation of relevant passages and statements</th><th>Analytic sub-results</th></tr>
<tr><td>1. Factor</td><td></td><td></td><td rowspan="3">• ………
• ………
• ………</td></tr>
<tr><td>Subcategory within this factor</td><td>0'00"-1'52"
2'04"-2'30"</td><td>• ………
• ………
• ………</td></tr>
<tr><td>Subcategory within this factor</td><td></td><td>• ………
• ………</td></tr>
<tr><td>2. Factor</td><td></td><td></td><td rowspan="2"></td></tr>
<tr><td>Subcategory within this factor</td><td></td><td></td></tr>
</table>

A high degree of intersubjective reliability regarding the analytical results from these interviews would require that another researcher coded and interpreted the interviews and from this would draw the same conclusions (Miles & Hubernman, 1994, Yin, 2003, Boolsen, 2006). It has unfortunately not been possible to undertake this type of reliability procedure regarding the coding process. However, it was considered that this way of presenting the analytic process would imply a possibility to follow the analytic procedure and thereby to explicitly portray the underlying basis on which the results and conclusions regarding these intervews have been drawn. The recorded interviews can therefore be compared with the interpretation and analytic results from this process to examine consistency or other aspects. It needs to be emphasised that the analytical process has only been applied in relation to the interviews with the relevant informants from the Malaysian companies. As will be pointed out in chapter 4, this reflect the primary focus on the receiving parties in the technology and knowledge transfer process.

In this regard, as will be explained in chapter 5, certain recorded interviews, which also have not been transcribed, will be referred to in their entirety and will therefore not undergo the same analytical procedure. These interviews have nonetheless been listened to carefully and repeatedly and the relevant documents related to these intervies, including the interview guides and more, will also be presented in chapter 5.

4. Key concepts and analytical framework

This chapter will present and define the focal concepts and notions that constitute the central elements of the analytical framework, applied in the analytical process of this thesis. A short introduction to the studies concerned with technology transfer in a climate context is first presented, which is followed by a more extensive literature review concerning the studies that specifically have focused on technology transfer in the CDM. This section will examine and discuss the methodological and analytical aspects of these studies and serves to provide a background for presenting the analytical framework of this thesis. The following section will present the framework, which will be applied to assess the role of CDM in relation to technology and knowledge transfer.

4.1. Literature review

4.1.1. Technology transfer in a climate change context

International transfer of technologies, in the context of climate change mitigation, has been addressed extensively in both the academic and the grey literature (Rip & Kemp, 1998, Worrel et al., 2001, Bennett, 2002, Thorne, 2008). Scholars and practitioners with a variety of academic backgrounds, e.g. economics, political science, international law, management, engineering, industrial relations, etc., have been addressing this subject, positioning it certainly as an interdisciplinary field of study (Martinot, et al., 1997, Metz, et al., 2000, Petersen, 2007). In this regard, different theoretical and analytical perspectives have been applied to study and understand technology transfer. This may have, together with other factors, including the inherent complexity of the subject, given rise to the absence of coherent overarching theories of technology transfer (Reddy & Zhao, 1990, Sagafi–nejad, 1991, Martinot et al., 1997, Watson et al., 2007).

The comprehensive special report on technology transfer by the IPCC Working Group III (Metz et al., 2000) provides a substantial contribution towards a basis to understand and assess the transfer of both GHG mitigation and adaptation technologies[1]. Based on findings from a wide range of studies the objective of the report was to identify the key macro–level barriers that reduce the transfer of EST's under article 4.5 of the UNFCCC and accordingly to suggest measures to overcome these. The report adopted a broad focus encompassing a variety of financial mechanisms to facilitate technology transfer, including climate change projects under the Global Environment Facility[2] (GEF), ODA, FDI, partnership agreements, etc. Furthermore, the conceptual framework advanced in the report comprised the involvement of a wide range of stakeholders, within different institutions and organisations, and considerations on their relation to technology transfer processes. It stressed the role of developed and developing countries' governments, international donor agencies, NGO's, private sector business, research institutions and

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[1] This IPCC report was based on an initial request by the subsidiary body for scientific and technological advice of the UNFCCC (SBSTA) to prepare a technical paper on methodological and technological issues related to technology transfer (Metz et al., 2000).

[2] See for example http://www.gefweb.org/ (2008a) for an overview of these types of climate change mitigation and adaptation projects under the GEF.

others, and their potential contribution to create enabling environments, through multiple levels of collaboration, for development and transfer of EST's. Initiatives aiming to enhance technology transfer, both within and outside of the UNFCCC–domain, e.g. EGTT, Climate Technology Initiative (CTI), GEF, and others, have largely incorporated the core elements of the conceptual framework of the report in their appraisals and activities. This include, inter alia, preparation of technology needs assessments, studies concerning enabling environments, policy analysis, etc.[3] (http://www.climatetech.net/, 2001, http://www.gefweb.org/, 2008b, http://unfccc.int/, 2008c).

Although the IPCC–report considered theoretical and analytical aspects related to technology transfer, the focus was primarily on providing recommendations to policy–makers in the respective governments of the parties to the convention. According to the identified barriers, the report therefore suggested measures to transform political, institutional, legal, and economic structures and framework conditions, which on a macro–level, could facilitate, and contribute to enhance international technology transfer. The objective of this thesis, cf. chapter 1, is to contribute to an increased understanding of the complex and dynamic processes concerning technology and knowledge transfer at the micro–level in concrete implemented CDM projects. As mentioned, this entails mainly to concentrate on the relationship and interaction between the companies involved in the specific projects. The report therefore does not provide a suitable analytical framework, which can be applied to address the research question put forward in this thesis.

4.1.2. Technology transfer and the CDM

The methodological approach to identification of studies that specifically have addressed technology transfer in the CDM was to search for articles, papers, books, etc., that prior to December 2007 had been published regarding this subject. The internet sites www.google.com and www.google.scholar.com was in this regard searched for relevant publications. Furthermore, in relation to preparing this thesis a collaboration agreement was made with the Danish UNEP Risø Centre (see www.uneprisoe.org), where a range of researchers have expertise regarding the CDM. Various publications were therefore recommended by employees from this centre. A subsequent strategy was to search these identified publications for additional publications in the reference lists and from this continue the search process. Although this method may imply that publications have been overseen, around forty publications have been taken into consideration.

The CDM has been the subject of a variety of studies but the specific issue of technology transfer under the CDM has been quite under–investigated within the academic domain (Doranova, 2007, Paulsson, 2007). To the extent studies have addressed this subject, it has most often been included as an element of different other overarching research interests. Various scholars have focused on international climate politics; the historic development, governance, and structure of the climate change regime. In this context, the potential role of the CDM to facilitate transfer of technology and knowledge to

[3] The framework understanding has also in general been widely adopted in different studies on the subject (see e.g. Amin, 2005, Nordqvist, 2005, Petersen, 2006).

developing countries has been stressed (Paterson, 1996, Gupta, 1997, Grubb et al., 1999, Richards, 2001, Kallhauge et al., 2005, Chasek et al., 2006, Robert & Parks, 2006, and others). These mainly political science based studies have often discussed technology transfer in relation to negotiations on the role of developed respective developing country parties in the climate change regime. Other studies have focused on economic aspects, e.g. the financial flows, supply and demand factors in the carbon market (for example CER–prices and volumes), project investment, etc., associated with the CDM (Ellis et al., 2004, Caapor & Ambrosi, 2008, IETA, 2007). To some extent these, carbon finance oriented studies, have also dealt with transfer of technology associated with the CDM. A growing number of studies have been focusing on the sustainable development impacts of the CDM–projects in the host countries (Markandya & Halsnæs, 2002, Olhoff et al., 2004, Cosbey et al., 2006, Olsen, 2007). Technology transfer is within this literature often seen as an element of the economic sustainability performance of the CDM–projects[4]. In Forsyth (2003, 2005, 2007) the subject of technology transfer has analytically been approached from theories on partnership arrangements and collaboration between public and private entities, in relation to governance issues of the CDM. Other studies, including Aslam (2001), Philibert, 2003, Humphrey (2004), Kline et al. (2004), Justus & Philibert (2005), TERI (2006), and Brewer (2007), have in quite different ways and from a broader perspective considered technology transfer in relation to the Kyoto protocols flexible mechanisms[5].

A limited number of studies have specifically addressed technology transfer through the CDM. In Forrister et al. (2006) and Haake (2006), a number of registered CDM–projects have been taken into consideration and studied according to the project participants' own statements concerning technology transfer in the respective PPD's. These studies have taken a mainly descriptive approach, but also analysed whether technology transfer takes place and whether specific factors (or variables), including project type, project size or type of greenhouse gas, influence this. Haites et al. (2006) applies a similar approach, but devotes further efforts toward assessing the specific nature of the technology and knowledge transfer. This includes an extended analytic framework, addressing the specific actors involved in the projects and additional differentiation between different types of equipment and knowledge transfer elements. The analyses undertaken in Dechezleprêtre et al. (2007) and Seres (2007) expands the number of cases under study and suggests additional variables that potentially drive technology transfer in the CDM.

The studies done thus far specifically addressing technology transfer through the CDM have essentially applied the same type of methodological and analytical approach. Predominantly through regression analysis, the objective has been to identify the key variables, across different types of projects, of varying size, implemented in various countries, sectors, and industries, etc., that influences technology transfer. Valuable insights accrue from these studies, but their analytical approach and methodology, which can be characterised as rather mechanistic, implies limitations and weaknesses. An

[4] The models applied typically involve assessing the effects on sustainability based on economic indicators applied in different types of economic analysis, e.g. cost effectiveness analysis, multicriteria analysis, etc.
[5] Others studies involving CDM and technology transfer, which do not easily fall into categories, includes for example Aronsson, et al. (2006) and Millock (2002).

underlying weakness concerning the reliability of the results of these studies, concerns their source of information, the CDM project design documents, since this is not evaluated or verified in other ways. It may in this regard constitute a limitation to undertake the assessment from desktop studies, which does not involve comparisons with additional information, e.g. empirical findings from field studies. The studies moreover focus on the origin of the technology, which may oversee the underlying arrangements and circumstances under which the technology has been supplied and implemented. Furthermore, the design of these studies, in search for causal explanations of the overall key drivers, does not enhance an understanding of the factors involved in the micro–level processes. These factors comprise the nature of the relationship and interaction between the transferee and transferor parties in the projects, and their respective interests, positions, and motivations. In relation to this, the previous studies concentrate to a limited extent on the nature of knowledge transfer related activities, and thereby contribute less to clarify and qualify the substance of this in the CDM. It nevertheless needs to be stressed that the analytical efforts in Haites et al. (2006) does provide a preliminary categorisation of the internal arrangements of the parties involved in the projects and the activities related to knowledge transfer.

In summary, as the above has shown, an analytical basis, preferably with theoretical underpinnings, to address the question and specific focus of this thesis has not been identified in the literature on the transfer of GHG–mitigation technologies.

4.2. Technology and technology transfer in this thesis

In both the academic and policy–related literature concerning climate change mitigation, the concept of technology transfer often denotes the transfer of installations or modifications of one or several interrelated technological measures, which cause a reduction in net emissions of GHG's (see Forsyth, 2003, Justus & Philibert, 2005, Watson et al., 2007, for similar descriptions). While these descriptions outline the expected outcome in environmental terms (GHG–emission reductions) of transferring GHG–mitigation technologies they are also rather imprecise. Metz et al. (2000) in this regard attempted to provide a more precise conceptualisation of technology transfer within the climate change context, which in the report was defined as:

]..”*A broad set of processes covering the flows of know–how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGO's and research/education institutions*.”]..[..”*The broad and inclusive term “transfer” encompasses diffusion of technologies and technology cooperation across and within countries*.”]..[..”*It comprises the process of learning to understand, utilise and replicate the technology, including the capacity to choose it to local conditions and integrate it with indigenous technologies*”.] (Metz et al., 2000;3).

As it appears from the above, this definition, and the basic understanding it denotes, reflects a wider and more comprehensive understanding of the different aspects of technology involved in the transfer process, than the before mentioned. It nevertheless also renders the notion of technology transfer hard to operationalise analytically in concrete terms owing to its rather all–encompassing nature (Nordqvist, 2005).

The relevant articles in the UNFCCC and the Kyoto protocol, cf. chapter 1, also contains descriptive elements concerning technology transfer and it is evident from these articles that technology transfer is recognised as encompassing different dimensions, including equipment, know–how, experience, practices and processes, etc. However, the official guidance and governance documents related to their respective operating institutions, i.e. the UNFCCC secretariat and the CDM's executive board, including their judicial frameworks, glossary of terms, etc., does not provide a further clarification of what the concept of technology transfer in this context comprises. Therefore, there is no apparent well–defined set of indicators or background within the UN climate change regulatory system, which can be applied as a natural point of departure to assess technology transfer in the CDM also taken into consideration the specific focus of this thesis. This necessitates a clarification of how the (combined) notion of technology transfer will be understood and operationalised in this thesis.

4.2.1. Technology

The concept of technology, the object of the transfer process, has been defined in numerous ways and little consensus seems to have emerged concerning the meaning, content and substance of the concept (McLoughlin, 1999, Müller, 2003, Amin, 2005). The various conventional definitions of technology can be categorized as representing three types of perspectives: 1) the technology as transformer perspective; 2) the technology as tool perspective; and 3) the technology as knowledge perspective (Ramanathan, 1994). The first perspective reflects a traditional understanding of technology as encompassing only the material side of production, i.e. the machines and equipment necessary to transform raw material into finished products[6] (Wei, 1995, Levin, 1997, Lorentzen & Granerud, 1999, Chandra & Zulkieflimansyah, 2003). The focus on tangible objects and artefacts also corresponds to a perception of technology as a ‘black box’ (Rosenberg, 1982, Lorentzen, 1998,). The technology as a tool perspective expands the concept to include man–machine interrelations by emphasizing the associated intangible factors, for example the skills, methods, and heuristic knowledge of humans. The third perspective opens up the technology black box further by understanding technology as a specialised body of knowledge, which can take certain forms, e.g. tools, processes, techniques, machines, materials, or procedures (Amin, 2005). Ramanathan (1994) suggests a fourth eclectic form of technology understanding, which attempts to incorporate the different perspectives into an integrative technology concept (see also Edquist & Edquist, 1979, Metcalfe, 1995, Sharif, 1994, Gullestrup, 2003). The varying perspectives evidently have implications for how the nature, process, outcome, etc., of technology transfer related initiatives are understood, carried out and assessed.

In continuation of this, the underlying basis of understanding technology in this thesis will draw on a conceptual framework in which technology is understood as comprising four interrelated dimensions or constituent elements: A technique, knowledge, organization, and product–dimension[7] (Müller, 1999, 2003). This division denotes a structural differentiation between the constituent parts, or dimensions of the same phenomena, of a given technology, which will be explained below[8]. At given points in time the various constituent parts can show certain qualities and linkages between them (Lorentzen, 1998). In addition to the structural characteristics, is also a process perspective, which emphasises, inter alia, the concrete process of transforming materials in relation to the technology (Müller, 2003, Jamison, 2004). Technology (and its dimensions) can furthermore be considered at different levels of social aggregation (Edquist & Edquist, 1979, Lorentzen, 1998). The unit of analysis and the specific focus of this thesis, concentrate on companies, which in this context are regarded as central socio–economic actors involved in facilitating implementation of technologies in specific

[6] Lorentzen & Granerud (1999) and Metz et al. (2000) points out, that economic and sociological theory concerning technology transfer in a North–South context, traditionally have applied this understanding of technology.

[7] This framework has been developed by a research group at Aalborg University (Lorentzen, 1998).

[8] The engineering and system analysis oriented approach reflected in this technology understanding highlights certain aspects of a technology. Other approaches aiming to differentiate or deconstruct the technology concept, have accentuated other aspects, for example, the cultural, political, and value related dimensions of technology (see e.g. Bijker et al., 1989, Jamison, 2004).

CDM projects. Therefore, technology will be regarded as single technologies or technological systems at the micro–level, i.e. firm or plant level (Lorentzen, 1998).

4.2.1.1. The technology dimensions

The technique dimension encompasses the material requisites, the tools involved and the labour processes associated with the material transformation process in question. Included in the technique component are the physical means of production or implements, e.g. the machines, devices, tools, instruments, etc., involved in the technical process in question. In addition to this are the raw materials and the energy inputs transformed or consumed in the same process[9]. These components are also termed as the 'hardware' elements of the technology (Lorentzen, 1998). As these processes are set in motion by physical labour, the technique component also includes labour processes.

The knowledge or 'software' dimension reflects the cognitive aspects of technology and comprises several elements (Jacot, 1997). A sub–element concerns the accumulated practical experiences associated with and obtained through the activities of both the operators and producers of the technology in question, which therefore is embedded or embodied in these agents (Bell & Pavitt, 1993, Levin, 1997, Müller, 1999). This technical empirical knowledge consists of the acquired skills, tacit knowledge, know–how and intuition concerning the handling of production materials, machines, tools, etc. (Müller, 2003, Bertelsen & Dahms, 2004). The formal and informal qualifications of the labour force therefore constitute an integral part of the knowledge dimension (Lorentzen, 1998)[10]. Moreover, this component also contains the more complex applied scientific theoretical insight and expertise related to the technology. This aspect predominantly concerns the relevant technology designers and developers. It can therefore be argued, that there exists a continuum or a hierarchy of the different cognitive elements within a technology, which also reflects an axis ranging from tacit knowledge to more formalised and codified knowledge[11] (Jacot 1997). A central argument, which is followed in this thesis, concern that knowledge related aspects are integrated in the other technology dimensions as well (Bertelsen & Dahms, 2004).

The organizational or 'org–ware' dimension of technology encompasses how and by what means the technique and knowledge dimension are combined in the production of goods and services (Ramanthan, 1994, Amin, 2005). This dimension is therefore understood as the organization of the work process and the knowledge associated with coordinating and managing the generation of productive outcomes. Central to these planning efforts are different communication processes, routines, managerial aspects, formal and informal covenants of the workplace, and more. At the plant or firm level,

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[9] Raw materials are understood broadly, encompassing also semi manufactured products and the information included in production of services.

[10] A central element of the discussions on this issue is that human knowledge to a growing extent becomes integrated and embodied in machinery, for example in control systems and computers (Lorentzen, 1998, Archibugi & Coco, 2005).

[11] Codified knowledge encompasses e.g. manuals, blueprints, technical specifications, patents, handbooks, and more. See Archibugi & Coco (2005), Dutrénit (2004), and Mytelka (2007), for a discussion of codified and tacit knowledge.

where the production scale is larger than single–person companies, planning of the production processes and the division of labour between workers and sections is necessary (Ramanthan, 1994)[12]. The organisational division of labour concerns both the intra firm arrangements and the wider and complex global division of labour, which the companies, at a higher level, are part of (Lorentzen, 1998, Dicken, 2004).

The product dimension constitutes an integral part of the integrative technology concept and denotes the immediate result of the productive processes associated with a given technology. This dimension comprises a variety of generative outputs and is in this regard to be understood broadly, encompassing both material and immaterial products (Lorentzen, 1998). The production of goods and services therefore incorporates a technique, knowledge, and an organisational element, which together constitutes the producing technology.

To the extent it is feasible, it is considered appropriate or ideal to take the different dimensions of technology into account when analysing technology transfer processes, as suggested by Müller (2003). By avoiding a narrow and one–dimensional perception of technology, i.e. the black box perspective, the intention is thereby to enable a more comprehensive understanding of the elements included in the transfer process. It was nevertheless considered that an extensive and independent understanding of the concrete intra–firm organisation and division of labour especially within the Malaysian companies involved in, and pertaining to, the specific CDM projects, would be of less relevance to this thesis. It needs to be underlined, however, that the concept of firm–level technological capabilities (see section 4.2.2.2.), which primarily is applied to characterise the software dimension, to some extent contains the organisational dimension of technology, by including the overall coordinative and managerial competences of the companies. The organisational dimension of the technologies relevant to the CDM projects addressed in this thesis is therefore integrated in the knowledge dimension. Furthermore, when technology and knowledge is mentioned as a combined concept in the following, it is only to underline that technology is understood to comprise the abovementioned combination of four dimensions.

[12] These planning arrangements may also be embedded in the organisational culture at the enterprise level (Levin, 1997, Kuada, 2003).

4.2.2. Technology transfer in the CDM – the analytical framework

As mentioned earlier, studies of technology transfer have within the climate change context and in others, defined and operationalised this combined concept in a number of ways (Chen, 1996, Martinot, et al., 1997, Wilkins, 2002, Amin, 2005). The various approaches, for example in relation to evaluations of the effectiveness and success of technology transfer initiatives, have emphasised certain aspects concerning the relevant actors involved, the nature of the processes, its effects, indicators, goals, and more (Martinot, et al., 1997, Kumar et al. 1999, Bennett, 2002). In this regard, it appears that a fundamental issue concerns how technology is conceptualised and operationalised since this relates to the substance of the transfer process.

Earlier understandings of technology transfer, which were especially inspired by neoclassical economic theory, regarded technology as a freely available capital good and therefore concentrated mainly on transfer of technology embodied in machinery, equipment, devices, and the like (Lall, 1992, 2002, Wangel, 1999, Doranova, 2007). This approach was later criticised for failing to recognize the different dimensions of technology, including the knowledge–related aspects, the complex interactions between the actors in the transfer process, and the transaction costs associated herewith (Lorentzen & Granerud, 1999, Metz et al., 2000, Chandra & Zulkieflimansyah, 2003). These later approaches, which began to emerge from the late 1970's, therefore to a larger extent incorporated these aspects. Technology was in this regard increasingly understood as accumulated firm–specific knowledge and information, contained in production processes, designs, and more (Wei, 1995, Martinot et al., 1997). Owing to the often tacit and cumulative nature of this technological and managerial knowledge, technology transfer processes were seen to imply more than the simple purchase of capital goods and therefore, fundamentally, entailed a complex process of organisational learning (Kuada, 2003, Bell & Pavitt, 1993, Chen, 1996, Levin, 1997, Amin, 2005, Bell, 1997, 2007). Interaction between the actors involved, including training, cooperation, and other activities that facilitate learning, were therefore seen as central elements in order to unfold, reconstruct, and successfully integrate the technology in another context (Bijker et al, 1989, Jacot, 1997). This understanding of technology, which is followed in this thesis, implies therefore to include, in the analysis, the processes whereby the receiving organisation gain access to, learn about, and understand the different aspects of the technology, including those that are tacit in nature. Transfer of technological hardware is therefore primarily interesting insofar as the transfer process facilitates a possibility for Malaysian companies to access valuable knowledge related to the functionality, composition, outlay, arrangement, purpose, etc., of the hardware.

In this thesis, the concept of technology transfer will be operationalised in a way that will provide a basis for a thorough qualitative characterization, assessment, and analysis of the CDM in relation to technology and knowledge transfer. In the following, an overall analytical framework is put forward, which comprise three primary factors or criteria's that will be taken into consideration in the analysis. These factors will also be operationalised as themes to guide interview questions. In relation to the interviews with key informants from the Malaysian companies, these factors will also constitute the key coding factors in the interpretative framework, which will be applied to analyse these interviews. The factors and the related sub–issues are presented in table 5 below. In short, the first factor primarily concerns, as a central demarcation issue, identification of the relevant companies and the existence, or establishment, of channels between these that facilitate transfer of technology and knowledge. The second factor is taken into consideration in order to conceptualise and undertake an assessment of the knowledge related aspects, and to some extent the organisational dimension, of technology transfer through the notion of firm–level technological capabilities. The third factor accounts for the historic background and development of the identified Malaysian companies, including the interaction with its relevant affiliated companies in Annex 1 countries, in order to assess the influence of the CDM on the activities and undertakings of the company. The subsequent sections will in further detail account for the specific content of these three factors constituting this analytical frame in the order they appear in the table. It is considered appropriate to present these in this sequence here, but they will not necessarily be arranged in this order throughout the thesis.

Table 5. The analytical assessment framework.

The role of the CDM in relation to technology and knowledge transfer	
Factors taking into account	**Sub–issues related to these factors**
Transfer from Annex 1 countries to Malaysia in (and through) concrete CDM projects	• Identification of the technology related transferee and transferor companies involved in the specific CDM projects, including the concrete involvement of these companies in the projects • Characterisation of the CDM project related internal arrangements relevant to the projects, which involve identification of the channels that facilitate transfer of technology and knowledge and the nature of the relations between the transferee and transferor companies • The previous CDM related activities of the identified transferee companies in Malaysia • Issues related to transfer of technological hardware components
Accumulation of firm–level technological capabilities in the Malaysian companies through CDM project involvement	• Technological learning processes facilitated through interaction between the relevant companies involved in the CDM projects, including training activities, exchange of knowledge, e.g. through cooperation, regarding implementation of the technology • Identification of the effects on the capability of the Malaysian companies (as a whole) to undertake new activities and/or to generate changes in the technology • The interests, ambitions, goals, hopes etc. of the relevant companies regarding their CDM project involvement and technology transfer • The process whereby adaptation, modification, reconfiguration, redesign, development etc., of the technological system pertinent to the CDM projects has taken place in order to overcome specific challenges, obstacles or barriers
CDM as an initiator – the historic account and background information on the activities of the Malaysian companies	• Historic assessment of the identified Malaysian (transferee) company, including the general company profile, its core business activities and project activities also before its CDM project involvement • The history and development of the relationship and interrelations between the Malaysian (transferee) company and the affiliated Annex 1 country (transferor) company

4.2.2.1. Transfer from Annex 1 countries to Malaysia through CDM projects

As pointed out initially, in chapter 1 and 2, the developing countries have in political negotiations on climate change, including discussions on the CDM, incessantly stressed that their involvement and obligations under the UNFCCC should be conditional on, inter alia, technology and knowledge transfer from the developed country parties[13]. As a basis for assessing technology and knowledge transfer in the CDM, the approach taken in this thesis will reflect this perspective. Therefore, the primary focus will be to assess whether and how international technology transfer, in this context from Annex 1 countries to Malaysia (as a Non Annex 1 country), is occurring under the CDM[14]. Various demarcation issues are associated with this in relation to identifying and drawing relevant boundaries of the actors involved, the nature of their internal relationship, origin of technology, and more.

The transfer notion inevitably implies that at least two entities can be identified between which the transfer can occur. It therefore appears to be an inherent aspect and a common area of clarification, in analysis assessing technology and knowledge transfer between countries how the receiving and transferring parties involved are understood and defined (Reddy & Zhao, 1990). In this thesis, the relevant transferee and transferor agents of technology transfer are generally understood as the companies, with respective head offices located in Malaysia and in an Annex 1 country, which reasonably clearly can be identified as directly and in concrete terms involved in implementation of the technological systems in the CDM projects. In the Malaysian context, the *transferees* include the companies hosting the CDM projects, manufacturers, technology providers, consultant companies, licensees of Annex 1 country companies, joint venture companies, and subsidiaries[15]. These companies are included since they can directly influence, and be influenced by, technology and knowledge transfer in the CDM projects[16]. To the extent it is feasible, the analysis will address the employees within these companies, e.g. managers, technicians, operators, etc., that have been involved in concrete activities associated with the implementation, installation, development, and operation of the technologies in the projects. The technology *transferor* parties are understood as the companies in Annex 1 countries that provide, facilitate access to, or enable the transferee companies to supply or implement technologies in the projects. These comprise e.g. the licensees, parent companies, joint venture companies, companies in partnership agreements, and others.

In relation to analysing the specific projects, this will involve an explorative element concerning a more specific and detailed identification of the relevant companies involved

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[13] This has often been formulated through the G77 and China (Chasek, et al., 2006, Paterson, 1996).

[14] This perspective off course overlooks the equally important transfer between developing countries. The intention is not to disregard or ignore this aspect but this is considered outside the scope of this thesis.

[15] The analysis will therefore not involve the local Malaysian subcontracting companies that are not related to or affiliated with the identified Annex 1 country companies, and which supply minor technology components and carry out different tasks in the projects.

[16] The Malaysian technology manufacture companies and/or companies that implement similar technological subsystems, or complete systems, as in the CDM projects addressed in this thesis, but who have not been involved in these, will also not be included.

in the individual projects. In relation to this demarcation issue, there exist different modes and mechanisms that facilitate technology and knowledge transfer (Amin, 2005). These include e.g. FDI, joint ventures, licensing, royalty agreements, turnkey projects, purchase of capital goods, technical agreements and various forms of cooperation arrangements (Bell, 1997, Kumar et al., 1999, Metz et al., 2000). In the context of technology transfer, these mechanisms appear to be especially relevant at the company level since they denote the commercial and technology–related relationships and ownership structures between the companies (Forsyth, 2003, 2005). As a mean to guide identification of the relevant companies, these modes and mechanisms are relevant to take into consideration in order to account for and place the project related technology transferor and transferee parties, and the interaction between these, within. The varying modes of transfer, which are related to the CDM projects studied in this thesis, are included as a central element of what will be referred to as the project related internal arrangements. These arrangements denote the internal structure of relations, interactions, and ties, through which flows of technology and knowledge can be channelled between the relevant companies in the projects. These channels may be pre–existing, and utilised in this context, and/or established through the CDM. Therefore, this assessment factor also involves an identification of the CDM related activities of the transferee company in order to address the existence or creation of these channels.

Table 6 below presents a schematic overview and analytic categorisation, which especially draws on Kumar et al., (1999), Metz et al. (2000), and Amin (2005), of the types of internal arrangements that during the initial phase of preparing this thesis appeared to be evident concerning the specific projects and companies[17]. This typology is provided as a basis for a further detailed account, in chapter 5, of the relations and interactions between the companies. As it appears, table 6 establishes technology developer, technology producer, and technology user companies as operational analytical entities according to their technology transfer related characteristics. The developer companies encompass the relevant transferor companies in the Annex 1 countries, which develop and possibly produce core components of the technological systems implemented in the specific projects. The producer companies denote the Non Annex 1 country companies that owing to the relations with the technology developer companies are able to manufacture and/or possibly implement the technology in question. The user parties are understood as the companies hosting the CDM projects, and the employees herein, which in concrete terms utilise and operate the technology in question[18].

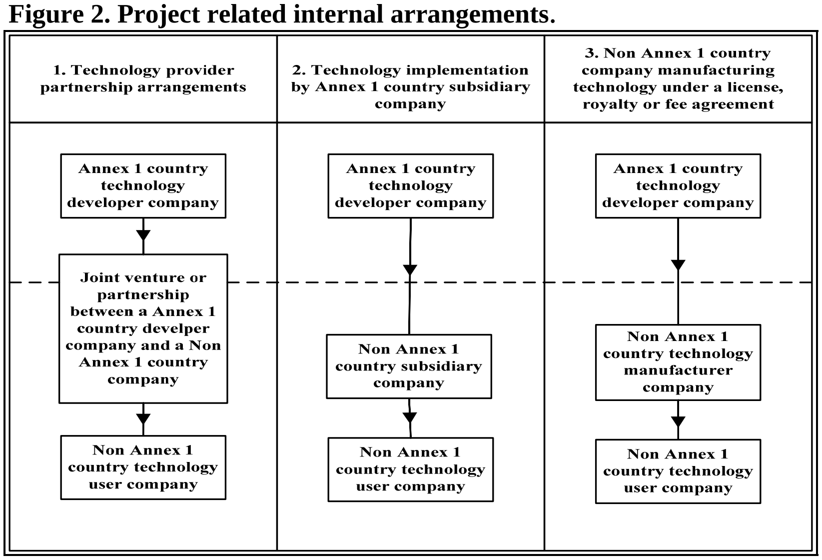
[17] This table and figure 2 are based on the initial round of telephone and email correspondence, which involved to address the identified companies pertinent to the specific CDM projects (see chapter 3) and has been further developed during the preparation of this thesis.
[18] The categories developed here does not claim to represent all possible project related internal arrangements pertinent to various CDM implemented in different countries.

Table 6. Analytic categories of the CDM project–related internal arrangements.

Modes and mechanisms of transfer	Characteristics of the transferor and transferee companies
1. Technology provider partnership arrangements	Transfer of technology and knowledge facilitated through joint venture companies or other partnership arrangements between an Annex 1 country technology developer company and a Non Annex 1 country company manufacturer, or another type of company that perform implementation of the technology, entailing also channels to the end users of the technology.
2. Technology implementation by Annex 1 country company subsidiary	The implementation of the technology or the technological system is handled, controlled, and undertaken by an Annex 1 country company operating through its subsidiary company, which is based in the Non Annex 1 country. This implies channels to transfer of technology and knowledge from an Annex 1 country to a Non Annex 1 country albeit within the company and to the technology end user companies of the technology.
3. Non Annex 1 country company manufacturing technology under a license, royalty or fee agreement	Manufacture of technology by a Non Annex 1 country company through a license, royalty, or fee agreement with an Annex 1 country technology developer company, which thereby facilitate channels of technology and knowledge to the Non Annex 1 company and to the end user companies of the technology.

The above table is shown graphically in figure 2, which present the internal arrangements in visual form. The dotted line symbolises the boundary between the Annex 1 country transferor sphere (above) and the Non Annex 1 country transferee sphere (below).

Figure 2. Project related internal arrangements.



The arrows in figure 2 illustrate the channels that facilitate transfer of technology and knowledge between the companies. Although these indicate a one–way process, which essentially reflects the focus of this thesis, the intention is not thereby to perceive the transferee companies as passive receiving actors[19]. In this regard, the concrete

[19] This aspect also concerns that the transfer notion does not constitute an unambiguous term and discontentment with its implicit connotation of a one–way process has led to other conceptualisations that,

involvement of the transferee companies in the specific projects, inter alia through interaction with the transferor companies, including exchange of information and technology cooperation, will also be taken into account.

As complete technological systems often comprise different subsystems in concrete implemented installations, this possibly involves a variety of channels in the transfer of technological hardware components, which may be outside the domain of the transferee and transferor companies identified above. Regarding the CDM projects addressed in this thesis, these components will be attempted identified, since this aspect concerns the hardware dimensions of technology. However, it was considered to involve an immense and maybe infeasible task to track down the origin of all minor components and subsystems comprising the various complete implemented systems in different projects. Therefore, the intention is in this regard to concentrate on the main or core components of the complete systems and to identify whether these originate from Annex 1 country companies. Yet, it needs to be reiterated that transfer of technological hardware is not important per se in relation to this thesis, but is primarily interesting insofar as the transfer process facilitates a possibility for Malaysian companies to access valuable knowledge and substantial insights into the hardware.

4.2.2.2. Accumulation of firm–level technological capabilities

A central element of the analytical frame concerns an assessment of the technological learning processes and its effects on technological capability building of the Malaysian companies, as a result of its interactions with Annex 1 country companies involved in the CDM projects. The following draws, in an eclectic manner, on a number of authors, theorists and empirical studies considering technology transfer as one mean, among others, to supplement and enhance the existing technological capabilities of developing countries' companies[20] (Lall, 1992, Dutrenit, 2004, Bell 2007).

Technology transfer can facilitate a possibility of tapping into the knowledge base of the external organisation and can thereby contribute to increase the skills, human, and organisational capital of the receiving company (Müller, 1999, 2003, Kuada, 2003, Humphrey, 2004, Mytelka, 2007). In this regard, a receiver perspective is adopted in this thesis, where focus primarily is on evaluating the benefits for the receiving Malaysian companies in terms of strengthening their technological capabilities regarding the specific technologies in the CDM projects (Müller, 1990). The notion of technological capabilities is therefore used as an effort to characterise, conceptualise, and qualify the knowledge dimension, and to some extent, the organisational dimension, of technology transfer[21].

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to a larger extent, understand technology transfer as a two–way process of interaction between the actors involved (Martinot, et al., 1997, Metz et al., 2000, Amin, 2005, Justus & Philibert, 2005).

[20] Malaysia is within this literature, along with a number of countries, frequently referred to as industrial latecomer countries, which may be a more appropriate term than developing country (Dutrenit, 2004).

[21] At the larger higher level of social aggregation, i.e. national, regional, or international, learning systems and technological capabilities are often included in assessments of national innovation systems, where technological capacities denote the aggregated capabilities of the social carriers of technology (Edquist & Edquist, 1979, Lorentzen, 1998, Doranova, 2007).

The concept of technological capabilities has since the 1980's become central to theories on engines of economic growth in developing countries (Lall, 1992, Lorentzen, 1998, Chandra & Zulkieflimansyah, 2003, Bell 2007). This interest emerged, inter alia, from the recognition of the increasing demand for enhancing the developing country companies' innovative capabilities in order for these to gain a competitive technological and commercial momentum[22] (Lorentzen & Granerud, 1999, Dutrénit, 2004). The focus on technology transfer in this context has been to address the factors that lead to, stimulate, and set into motion a continuing learning process in the receiving companies entailing, inter alia, further change and development of the initially acquired technology and existing technologies (Bell, 1997). In this regard, technology and knowledge transfer can through facilitating a learning process, contribute to develop the dynamic and innovative technological capabilities of the companies (Bell & Pavitt, 1993). In this literature, firm–level technological capabilities denote a company's ability, as a whole, to utilise technological knowledge efficiently to assimilate, use, replicate, adapt, and generate changes in existent technologies and the ability to develop new technologies, products, and processes (Lall, 1992, Dutrénit, 2004, Figueiredo & Vedovello, 2005). The basic proposition is that firms (as organisations) can learn and accumulate knowledge over time, among other things through technology transfer, which enables companies to undertake new and progressively more demanding innovative activities. This can furthermore stimulate the acquirement of additional technological capabilities[23]. This process is understood as gradual and evolutionary, and therefore path dependent, in which sequential stages or levels of capability accumulation can be identified (Bell, 1997, Dutrénit, 2004)[24]. In this thesis, the central aspect is that the identification of these capability levels can provide an understanding of the companies' competences regarding the specific CDM project–related technologies. Moreover, this identification renders it possible to assess what role the CDM project involvement, through transfer of technology and knowledge, and as a learning process over time, entail for the enhancement of the Malaysian companies' technological capabilities. It has been suggested that a more integrated, binding, and shared nature of the technology related ownership relations, between the transferor and transferee company, imply a larger willingness to exchange valuable information regarding the technology (Bell & Pavitt, 1993, Bell, 1997, Kumar et al. 1999, Forsyth, 2003).

It appears that the concrete characterisation and properties of the technological and organisational learning processes, relevant to technology transfer initiatives, have been

[22] This interest has especially evolved from experiences from the Asian NIC countries' industrial and economic development in relation to technology transfer (Dutrenit, 2004, Amin, 2005).
[23] Other factors than technology and knowledge transfer may influence the development of companies' technological capabilities, including the educational system, labour market arrangement, and other institutional aspects, structures, regulations, and policies of the country in which the company is located in (Domínguez & Brown, 2004).
[24] This reflects the inspiration from the theories of evolutionary economics (se e.g. Lall, 1992, Dutrenit, 2004).

considered in various ways in the literature on firm–level technological capabilities[25] (Bell, 1997, Wangel, 1999, Chandra & Zulkieflimansyah, 2003, Kuada, 2003). It has therefore not been possible to identify a comprehensive classification of the concrete activities and mechanisms facilitating learning in this context. It seems clear, however, that the process of transferring knowledge, which is accumulated in the transferor company, necessitates close interaction with the transferee company in order to facilitate access and insight into matters concerning operation, maintenance, implementation, design, development, etc., of the technologies in question (Bell, 1997, Levin, 1997, Lall, 2002, Müller, 2003). This technological knowledge, either tacit or codified in nature, and possibly embodied in firm–specific routines and structures, may entail various forms of interaction, including collaboration, instruction, supervision, training activities, and more, to induce accumulation of technological capabilities in the transferee company (Bell & Pavitt, 1993, Bell, 1997, Kumar et al., 1999). The intention regarding the key informant interviews performed in relation to this thesis, has been to formulate the interview questions in a matter, which allows the informants to describe, in their own words, the nature of interaction, and which kind of activities this has subsequently enabled the Malaysian company to perform.

Following Lall (1992), Bell & Pavitt (1993), Wei (1995), Kumar et al. (1999) and in particular Bell (1997) and Müller (1999, 2003), technology transfer is viewed in this thesis as a dynamic assimilation process over time, which can contribute to increase the firm–level technological capabilities of the transferee companies. It is therefore the objective to assess and identify what role the CDM, through technology and knowledge transfer, play in relation to accumulation of the Malaysian companies' technological capabilities through their involvement in CDM projects. Different taxonomies or taxonomic models to characterise and analytically operationalise the development and achievement of different capability levels have been advanced to address this issue (Lall, 1992, Dutrénit, 2004, Figueiredo & Vedovello, 2005, Bell, 2007). These models typically involve a classification of the increasing complexity of the company's activities that characterise the capability levels and in relation hereto often include a comprehensive specification of the related technological and organisational functions within the company[26] (Dutrénit, 2004). Although this thesis fundamentally applies a similar approach, the analytical model prepared for this thesis is simpler and will not contain as comprehensive and detailed information, especially regarding the functions, as the above. Therefore, the levels of technological capabilities of companies, in this thesis, denote the necessary knowledge, including the coordinative, managerial, and organisational capacity of the company, as a whole, to undertake certain activities regarding the technology in question. In table 7 below, the taxonomic model is presented, which features three levels of capabilities and the properties that characterise these levels. The model serves to

[25] Learning processes have for example been categorised in terms of activities involving learning by doing, learning by operating, learning by changing, and more (Metcalfe, 1995, Levin, 1997, Chandra & Zulkieflimansyah, 2003).

[26] These functions within the company comprise, for example, pre–investment functions (e.g. feasibility studies), project execution, process and product engineering, industrial engineering, linkages within the economy, etc. (See e.g. Lall, 1992, Figueiredo & Vedovello, 2005). It requires a long period of continuous study of the company in question and numerous interviews with individual employees to reach a comprehensive understanding of these aspects.

provide an analytical basis for a qualitative assessment of the capability level of the Malaysian companies, both prior and subsequent to their involvement in CDM projects. In order to enable an identification of these levels, in relation to the respective companies, the questions guiding the key informant interviews have also been prepared to address these issues.

Table 7. The levels and properties of firm–level technological capabilities.

Levels of capabilities	Properties related to the levels of technological capabilities
Basic (Know–how)	• Capabilities to use, operate and maintain the technological equipment, devises, machinery, etc. subsequent to implementation of the technology, including undertaking replacement and repair of minor components • The capability, primarily concerning the respective operators, to secure and maintain an efficient level of productivity (at best at its design levels of performance)
Intermediate (Know–what)	• Capability to replicate and/or independently undertake complete implementation, including possibly fabrication, of technological components, technological subsystems or complete systems • The capability to independently undertake incrementally minor adjustments, modifications, improvements, optimisation, etc. in relation to specific application requirements and contexts
Advanced or innovative (Know–why)	• Capability to generate more substantial changes and developments in the technological component, technological subsystem or complete system in question • The capability to undertake reconfiguration and redesign of the basic technology outlay, develop new designs or elements of the system, or of the complete system, including possibly to continuously optimise the system performance through engineering R&D related activities

As can be seen in the table above, the model depicts the level of technological capabilities necessary for the company to carry out increasingly more demanding, complex, and innovative activities regarding a given technology. The basic capabilities, or the know–how, primarily concern the users of the technology and denote the knowledge and skills needed to operate, repair, and maintain the technological hardware[27]. The intermediate level, the know–what, refers to the capability required to undertake implementation, including managing coordination of the installation, of the technological component, subsystem, or complete system in specific projects, and possibly also concern manufactures of the technology. This level also includes the ability to perform minor adjustments and improvements concerning implementation and performance of the system. The innovative capabilities denote the resources of companies needed to generate, manage, and undertake fundamental changes in the configuration and design outlay of the system. This requires insights into the basic and underlying scientific principles of the technology, including the critical system measurement parameters, calculations, dimensions, etc. and may therefore be referred to as the know–why (Lall, 2002, Müller, 2003).

This assessment factor also addresses the respective strategic interests of the companies involved in the process of, and aspects relating to, technology and knowledge transfer.

[27] According to Müller (2003) and Lall (2002), technological capability accumulation in relation to technology transfer initiatives is often limited to enable the relevant operators to carry out operation and maintenance.

There may be different interests influencing these processes, including the potentially diverging intentions, motivations, ambitions, hopes, and aims pertaining to the respective involvement of the transferee and transferor companies (Bell, 1997). In this regard, companies that develop technologies generally seek in different ways to retain strategic control over the core areas of their technology and tacit knowledge, through intellectual property rights (IPR's), patents, and more, to hinder an uncontrolled dissemination of these aspects (Dicken, 2004, Justus & Philibert, 2005). In this context, the ownership structure between the companies, pertinent also to the rights of the technology, may constitute one opportunity, for the technology developer companies, to handle and control their valuable assets in relation to activities and operations in other countries, including technology transfer initiatives[28] (Bell, 1997, Kumar et al., 1999, Forsyth, 2005).

Most technology and knowledge transfer processes involves an adaptation phase, especially regarding introduction of new technology in a company or country, owing to that different application contexts imply challenges to the optimal performance of the technology. The technology therefore undergoes changes to meet these conditions and requirements (Lorentzen, 1998, Müller, 2003). If considered relevant, these adaptation processes will be taken into account as these technological challenges, obstacles or barriers may entail interaction between the involved companies.

4.2.2.3. The CDM as initiator of technology and knowledge transfer activities

This aspect of the analytical assessment framework concerns a historic assessment of the identified Malaysian transferee companies and focuses on the development, the company's core business activities, and the general profile of the company. In this regard, the intention is also to address these companies' various project activities prior to the possibility of participating in CDM projects. This element therefore addresses the novelty of the specific technological systems implemented in the CDM projects, seen in relation to prior applications in Malaysia of the companies' technologies, which implicitly have implications concerning the technological additionality of the projects. Furthermore, the history and development of the transferee companies' affiliation with the identified Annex 1 country companies will also be taken into consideration. This assessment will address the nature of the relationship and interaction between these companies that has been evident prior to the CDM. Thereby, the analysis attempts to include the pre–existing engagements, which may still be evident, that facilitate transfer of technology and knowledge, in order to place the CDM within a historic context. The intention is thus to understand and assess whether the CDM initiates changes in the nature of the internal relationship and interaction patterns between the companies. Moreover, this also provides a possibility to understand whether the CDM essentially implies a continuation of the standard activities of the transferee company.

[28] Contractual agreements and arrangements that ties the companies close and in binding terms together, e.g. through license, joint ventures, subsidiaries, etc., may therefore be an appropriate choice for these companies.

5. Analysis

5.1. Prefatory note concerning CDM project no. 247

In this chapter, the results from the analysis undertaken in this thesis will be presented. It needs to be emphasised, however, before these results are presented, that a key decision was taken during the fieldstudy in Malaysia to exclude one of the fourteen registrered projects, which at the outset was considered relevant to include in the analysis (see chapter 3). This concerns CDM project no. 247, which involve implementation of a cogeneration system that utilises biomass residues to substitute coal in the production of cement at two cement factories in Malaysia, owned by Lafarge Malayan Cement Berhad (LCMB) (UNFCCC, 2005b, see also www.malayancement.com). According to the PDD, the development and deployment of the technological system in this project has been handled and undertaken within the Lafarge Group, which LCMB is part of (UNFCCC, 2005b, see www.lafarge.com). Previous to the fieldstudy period, the deputy CO_2 project manager of Lafarge S.A., Mr. Gaillard Bertrand, who was registered in the PDD, as well as the former CO_2 project manager, Mr. Gaëtan Cadero, were consulted in order to understand the company's role in the specific project[1]. From this, it was evident that these persons possessed very limited knowledge concerning this CDM project activity. Therefore, an interview was arranged and performed with the general manager of the alternative fuels and environment division of LCMB, Mr. Mohammed Dit, on March the 12th 2008 at the head office of LCMB. However, owing to very limited time available (in concrete terms) to conduct the interview, it was performed hastily. This entailed that the interview unfortunately, owing to the short time frame, did not generate adequate or enough data and information to be the subject for completion of a comprehensive analysis. Furthermore, it has proven hard to identify detailed information regarding this CDM project from other sources, including the Internet. In summation therefore, this project will not be taken into consideration in the following analysis owing to a lack of sufficient data.

5.2. Introduction to the analysis

On this background, thirteen CDM projects constitute the basis on which the following analysis has been undertaken. At the outset, it needs to be emphasised that the PDD's and/or validation reports pertaining to these projects all contain descriptions of how these projects contribute to facilitate technology and knowledge transfer to Malaysia. In the following assessment, each case denotes the constellation of companies involved in specific CDM projects, between which transfer of technology and knowledge can occur. Five cases will be presented of which the first four concentrate on projects where boiler systems, which utilise biomass residues to generate energy, have been implemented. The fifth case concerns the implementation of a landfill gas recovery system and refers to a single CDM project activity. In each of the cases examined, an identification of the relevant companies that constitute the case in question will first be presented. Thereafter, a short introduction to the specific technological systems that have been implemented in

[1] Personal communication (email and telephone) with Mr. Gaillard Bertrand and Mr. Gaëtan Cadero from Lafarge during the period between November and December 2007, for a discussion on this issue.

the CDM project(s), pertinent to the specific case, will be provided[2]. This is followed by a presentation of the key informants and an assessment of the background and development of especially the Malaysian based companies involved in the respective projects. The analysis will subsequently concentrate on the interaction between the companies throughout their CDM project involvement and account for the accumulation of firm–level technological capabilities and transfer of technological hardware. As can be seen, the analysis will include an assessment of the three key factors from the analytical framework, including the sub–issues within these, in each case. Lastly, a summary of the key findings relating to each case is provided.

The references pertinent to each of the cases examined will be provided at the end of the analysis of the respective cases, in order to avoid an unnecessary long reference list in the end of the thesis. Furthermore, as mentioned, all interviews taken into consideration in the analysis are appended in Appendix 3 in the order the cases and interviews appear in the following. In relation to the interviews undertaken with the Malaysian based transferee companies' employees, which have been analysed on the basis of the analytical framework, as explained in chapter 3, these will be appended in a matrix format. The interviews that have been conducted and recorded, but which have not undergone the same analytical procedure, are referred directly (in their entirety) to Appendix 3 and it will be evident throughout the analysis, which interviews this concern. In Appendix 4, the seven company and project presentation papers obtained mainly from visits to the transferee companies' head offices, during the field study period in Malaysia, are appended on a CD ROM. In the following analysis, Appendix 4 will be referred to in each case and the papers that are relevant for the case in question will appear from the Appendix.

During the field study period in Malaysia, a possibility arose to undertake interviews both with employees from the Malaysian DNA and the Malaysian Energy Centre regarding CDM related issues[3]. These institutions are both involved in the internal Malaysian approval process in relation to CDM projects. Although the primary focus in this thesis concerns the companies involved in the CDM projects, this opportunity was considered relevant in order to gain insight into the institutional aspects of technology and knowledge transfer in the CDM. Therefore, meeting arrangements were made with relevant employees to conduct these interviews. An assessment of these interviews will be presented in chapter 5 (section 5.8.) subsequent to the main analysis of the five cases.

As mentioned in chapter 3, a comprehensive interview guide was prepared before all interviews conducted in relation to this thesis. The interview guides pertaining to the five cases addressed in the following, have been constructed in an identical manner to address the same issues. The intention has been to operationalise the three overall factors from the analytical framework. The first questions in the interview guide address background information relating to the company in question. This is followed by a series of questions

[2] This description will not minutely account for the technical details regarding the specific configuration and function of the different technologies since this information may not be attainable and a comprehensive account of the complex sub–systems is considered outside the scope of this thesis.
[3] This was facilitated through Mr. Søren Warming of the consultant company SV Carbon.

concerning the nature of the interaction between the relevant companies prior to their CDM project involvement. Subsequently, the interview guides contain questions that concentrate on the concrete interaction between these companies throughout the specific project(s). Lastly, the questions focus on the accumulation of technological capabilities and learning, especially regarding the Malaysian companies involved.

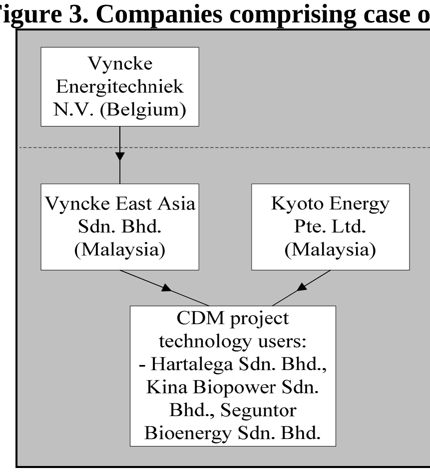
5.3. Case one – Vyncke Energitechniek N.V.

5.3.1. Identification of the actors and projects addressed in this case

Based on an initial assessment of information attainable in the specific PDD's that constitute the point of departure of this thesis, the Belgium based company Vyncke Energitechniek N.V. was identified as the technology provider to three registered CDM projects in Malaysia. These projects comprised the Biomass Thermal Energy plant – Hartalega Sdn. Bhd. (CDM project No. 1186) (UNFCCC, 2007), the Kina Biopower 11.5 MW EFB Power Plant (CDM project No. 385) (UNFCCC, 2005a), and the Seguntor Bioenergy 11.5 MW EFB Power plant (CDM project No. 386) (UNFCCC, 2005b)[4]. Information regarding the end users of the implemented technologies, i.e. the project host companies, was also registered in the PDD's and encompassed Hartalega Sdn. Bhd., Kina Biopower Sdn. Bhd., and Seguntor Bioenergy Sdn. Bhd.

Vyncke Energitechniek N.V. was consulted prior to the field study period for a further examination and identification of additional potential technology relevant companies pertinent to these specific CDM projects[5]. The Malaysian based affiliate company of Vyncke Energitechniek N.V. – Vyncke East Asia Sdn. Bhd. – was on this basis identified as a key actor in this context. In addition, the Malaysian office of the Singaporean based company Kyoto Energy Pte. Ltd. was identified as relevant to take into consideration. Kyoto Energy had been involved in the management of all CDM related aspects for Hartalega Sdn. Bhd. regarding project #1186. In summary therefore, figure 3 below illustrate the constellation of companies, and the possible interrelations between these, selected to be included in further analysis[6].

Figure 3. Companies comprising case one.



[4] These projects will in the following be referred to as project #385, #386, and #1186.
[5] Personal communication (email and telephone) with Mr. Johan Collins and Mr. Vincent Weyne from Vyncke Energitechniek N.V. during the period between November and December 2007 for a discussion on this issue.
[6] See also www.vyncke.com and www.kyotoenergy.net for information on Vyncke and Kyoto Energy.

As the figure above indicates, the main focus regarding this case concerns the CDM related activities of Vyncke Energitechniek N.V. and its affiliated company in Malaysia. A meeting for an interview with a representative of this company was thus secured early in the process of preparing this thesis. The executive director of Hartalega Sdn. Bhd., Mr. Kuan Mun Leong, was also consulted in order to arrange a meeting with this company. Unfortunately, due to time constraints, neither he nor other company employees were able to participate in an interview during the field study period[7]. It was expected however, that an interview with a representative from Kyoto Energy Pte. Ltd. could provide detailed (although secondary) information concerning the CDM project #1186, in regard to the experiences and involvement of Hartalega Sdn. Bhd. in this project.

In relation to project #385 and #386, it appeared that these projects had been delayed and were therefore, during the field study period, still undergoing construction. On this basis, it was considered irrelevant to carry out and include an interview with the project host companies concerning these projects in this thesis. The argument here fore was that these companies would not be able, simply due to the incipient state of the projects, to describe matters concerning their concrete involvement, experiences, and the subsequent influence that the CDM projects have had on the activities of these companies. An assessment of these projects and companies will only be addressed in the analysis insofar as these are discussed in relation to the general CDM–related experiences of Vyncke Energitechniek N.V. in Malaysia. The assessment fore taken in the following will therefore primarily concentrate on the project #1186.

5.3.2. Technological systems implemented in the specific projects

Project #385 and #386 are identical in both nature and content, and are located within short distance of each other in an industrial site in East Malaysia (UNFCCC, 2005a, UNFCCC, 2005b). The technological content of these two projects, is to implement a complete power generation plant with 11.5 MW generation capacity that utilise empty fruit bunches (EFB's), which is a biomass waste material from the Malaysian palm oil industry, to generate electricity. The boiler system will be supplied by Vyncke Energitechniek N.V. (Ibid., http://www.bernama.com.my/, 2007).

Hartalega Sdn. Bhd., which is the project host company of project #1186, specialises in production of different types of high quality rubber gloves for the food industry and medical applications (see www.hartalega.com). The industrial processes involved in the production of these goods require large amounts of thermal energy in the form of hot air and hot water (UNFCCC, 2007). This energy demand has traditionally been sourced from conventional fossil fuel (natural gas) fired boilers installed at the production site. The technological nature and content of this CDM project activity consists of replacing these conventional boilers with EFB–fired biomass boilers supplied by Vyncke Energitechniek N.V. The project is undertaken in two phases where the first phase will replace the existing boilers and the second will add additional thermal capacity to feed new planned production lines as per expansion plan of Hartalega Sdn. Bhd. The implemented biomass boiler system consists of a range of technological sub–systems, including a water–cooled

[7] Hartalega Sdn. Bhd. was undergoing an IPO, which in this period was very intense, and time consuming.

reciprocating step grate combustion system, combustion chamber, wet de–ashing system, silo, boiler, unloading system, fly ash evacuation system, dust filter and induced draft fan, etc.[8] (Ibid., Appendix 4).

5.3.3. Analysis

The first interview which is of primary importance to this case was undertaken on March the 17th 2008 in Kuala Lumpur at the Vyncke East Asia Sdn. Bhd. head office with the regional sales manager Mr. Vincent Weyne accompanied by sales manager Mr. Goh Kheng Leng. A document was send to Mr. Weyne preceding this interview explaining the topics of discussion that would be addressed during the interview (see Appendix 5). In Appendix 6, the questions that were prepared in advance to guide the interview are also given. This interview guide depicts how the specific questions, prior to the interview, were formulated into themes in order to operationalise the factors constituting the analytical/interpretive framework presented earlier. Furthermore, the analytical coding and interpretation process, concerning this interview, which has generated the main analytical results presented in this section, is provided in Appendix 7. The second interview was conducted on March the 21st 2008 with the Asia pacific director of Kyoto Energy Pte. Ltd., Mr. P. Krishnamurthy, at the company's representative office in Kuala Lumpur. In Appendix 8 and Appendix 9, the topics of discussion and the interview guide, in relation to this interview are appended. This interview will be referred to as (Krishnamurthy, 2008).

Vyncke Energitechniek N.V. has a long company history that started in Belgium in 1912, which ever since its foundation has specialised in production and development of boiler technologies that utilise varying types of biomass waste materials to generate energy (Appendix 4, see also www.vyncke.com). The company at present occupies 270 employees worldwide and its business activities and boiler system applications span across a variety of countries[9]. Development and innovation regarding the engineering design of the core technological components in the boiler system, i.e. the patented water–cooled step grate combustion system, the heat exchanger system, the control and regulation system, etc., is primarily being done at the Belgium head office (Appendix 7). Production of these components has until recently been undertaken in Belgium, but these activities, including also innovation and development related activities, have gradually been moved to the Vyncke owned companies in China and The Czech Republic.

As its primary business strategy, Vyncke spread its activities and boiler system applications in many countries and in varying industries within these. This practice entails that the company implements tailor–made boiler system solutions according to the diverse application contexts and requirements, and can in this regard undertake all activities related to design, engineering, production, installation and commissioning to training and after–sales service in given projects (Appendix 4). It is common practice for

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[8] Owing to its sensitive nature, it has unfortunately not been possible to obtain in–detail technical drawings and comprehensive information regarding the specific project installations, despite of its relevance for this study.

[9] Among these are The Czech Republic, Germany, Brazil, Thailand, Malaysia, Singapore, Australia, Canada, and more.

Vyncke to supply the core components in complete boiler system installations and to procure technological hardware subcomponents and equipment from countries in close distance, including also from local subcontracting companies[10] (Appendix 7). These components are chosen based on their reliability and cost efficiency.

It appears that the internal organisational structure of the company implies that the different Vyncke owned companies registered in different countries, among this Vyncke East Asia Sdn. Bhd., are in fact regional representative offices and therefore not independently operating subsidiary companies. The activities of these regional offices are thus organised and controlled by the Belgium head office and communication between these occur on a daily basis. The Vyncke regional office in Malaysia has existed since the late 1980's and the activities of Vyncke in Malaysia, prior to its involvement in CDM projects, have included boiler system applications in different industries utilising various biomass materials (http://cdm.unfccc.int/, 2008, http://www.cogen3.net/, 2008).

In relation to the company's involvement in CDM projects in Malaysia, Vyncke has continued its standard business strategy and practice by developing tailor made boiler system solutions according to the specific application requirements in these projects (Appendix 7). In this regard, the company has operated through pre–existing channels facilitating flow of technology and knowledge between the Vyncke head office and the Vyncke East Asia Sdn. Bhd. office (i.e. between countries albeit within the same company). In relation to the projects end users, for example the employees at Hartalega Sdn. Bhd., the CDM have established new channels that facilitate a possible flow of technology and knowledge. In reference to chapter 4, these technology related interrelations therefore correspond to the second categorical type of project related internal arrangements, since these relations seem to be evident in all projects pertinent to this case. For Vyncke, as a company, the participation in CDM projects is not a priority per se but it is considered that the associated CER revenue increase the investment interest in these types of projects and thereby essentially enables the company to further its boiler system applications in Malaysia (Appendix 7).

A wide variety of companies exist, which have subcontracted and supplied varying technological hardware components, equipment and installations, incorporated in the complete boiler systems implemented in the three projects[11]. Though it is outside the scope and interest sphere of this thesis to include an assessment of the local Malaysian subcontracting companies, it is nevertheless relevant, to a minor extent to consider these, due to their explicit interest and concern of Vyncke in relation to technological learning (Appendix 7). In the projects, the Malaysian subcontractors have been involved in supplying, inter alia, the boiler, the supporting structures; steel parts, ducting, refractory lining, etc., based on specific production requirements from Vyncke. To prevent local technological learning regarding the core technologies and the design of the concrete

[10] These procured components typically comprise the less complex parts and/or those with high transport costs.
[11] These include companies from a number of countries in South East Asia. Specific information concerning these companies (and components) is seen as sensitive to Vyncke (Appendix 7). It has therefore not been possible to obtain this type of information.

boiler system installations, Vyncke exercises a clear protective strategy to hinder this type of knowledge and information from diffusing to e.g. local subcontracting companies and other companies. These local companies are therefore kept from gaining insight into the specific application and purpose of the components they supply. The technological learning impacts may therefore be limited to these companies. Vyncke adopt similar technological learning considerations towards the end users, e.g. employees at Hartalega Sdn. Bhd., although these to a certain extent also have been involved in preparing the conceptual design and overall outlay of the system. The training activities that Vyncke have performed of the end–use operators of the technological systems have been undertaken in order to enable these to carry out efficient operation and maintenance of the system (UNFCCC, 2007, Krishnamurthy, 2008, Appendix 7).

In the PDD for project #1186 (and in project #385 and #386) it is held that there exists a range of technological barriers. These barriers primarily concern the fuel characteristics of EFB's, that contribute to render the specific project activity unattractive to venture into for the project developer and therefore unlikely to be undertaken in the absence of it being a CDM project (UNFCCC, 2005a, UNFCCC, 2005b, UNFCCC, 2007). EFB's typically has high moisture content, low calorific value, and a low ash melting point, which can create problems with clinker formation in the combustion phase, in comparison to other biomass residues from the Malaysian palm oil industry (UNFCCC, 2007). The technologies to utilise EFB's as a biomass fuel in boiler systems are, it is argued, not well proven and needs to be developed or modified further to overcome the challenges and obstacles associated herewith. In the Malaysian context this argument, which concern additionality, seems to be supported (Appendix 7, E. consulting & M. Holdings, 2006, http://cdm.unfccc.int/, 2007). This is not only relevant in relation to this case but concern all the projects taken into consideration in this thesis that involve utilisation of EFB's in boiler system technologies. Vyncke has in this context, in the initial phase of the Hartalega project, undergone a learning process through which the boiler system has been adjusted and adapted, where after these modifications have been applied in the second phase of the project implementation[12] (Appendix 7). This process is a well–known activity for Vyncke, which, as mentioned, has many years of experience from different countries in handling biomass fuel materials that are difficult to utilise in boiler systems. It also needs to be mentioned that the PDD's pertaining to this case stress the lacking level of skills of the relevant operators as a primary element of technology transfer in the projects.

5.3.4. Key findings

This case primarily focuses on the CDM related activities in Malaysia of the Belgium company Vyncke Energitechniek N.V., its regional Malaysian office and the CDM project host company Hartalega Sdn. Bhd. Vyncke has a long company history of boiler systems development and application, including handling varying biomass materials, and has been active in Malaysia since the late 1980's. It seems evident that the CDM, quite

[12] It is not thereby implied that the fundamental configuration and design of the Vyncke boiler system has been rearranged and changed in relation to these projects. Rather, the system has been adjusted to meet the specific project related requirements.

simply, has initiated further applications of the boiler system and that the system in this process has undergone adjustment and adaptation. The projects that Vyncke have been involved in have entailed transfer of a range of technological hardware components from various countries, including the core components from Belgium, The Czech Republic, and China, sub–systems from different countries in South East Asia, and other countries. The technological learning impact concerning the project host companies have been limited to enabling their employees to operate and maintain the boiler systems. On this background, the CDM has played a limited role in relation to transfer of technological knowledge and information, which could enable local companies to implement and over time develop similar boiler system applications. It is therefore suggested that the CDM have facilitated limited accumulation of technological capabilities of the local Malaysian companies involved in this case.

References – case one

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5.4. Case two – ENCO Systems Sdn. Bhd.

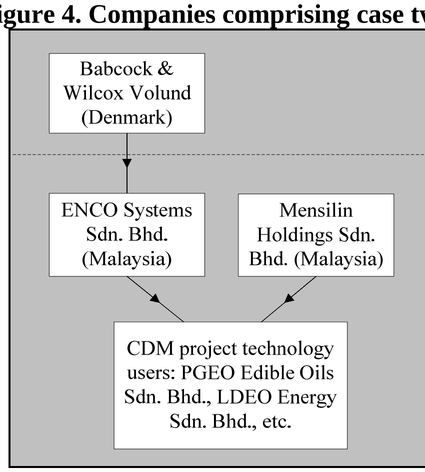
5.4.1. Identification of the actors and projects addressed in this case

On the basis of the preliminary assessment of the PDD's taken into account in this thesis the Malaysian company ENCO Systems Sdn. Bhd. was identified as providing technology to seven registered CDM projects in Malaysia, under a partnership agreement with the Danish based company Babcock & Wilcox Volund A/S (B & W Volund). The project title, the related CDM project numbers, and the project host companies pertinent to these seven projects are presented in the matrix below.

Project title	Project host company	No.
Biomass Energy Plant Lumut (UNFCCC, 2005)	PGEO Edible Oils Sdn. Bhd.	# 249
LDEO Biomass Steam and Power Plant in Malaysia (UNFCCC, 2006a)	LDEO Energy Sdn. Bhd.	# 395
SEO Biomass Steam and Power Plant in Malaysia (UNFCCC, 2006b)	Sandakan Edible Oils Sdn. Bhd.	# 402
Bentong Biomass Energy Plant in Malaysia (UNFCCC, 2006c)	Pascorp Paper Industries Berhad	# 501
ENCO Biomass Energy Plant in Malaysia (UNFCCC, 2006d)	Kulim Industrial Estate	# 502
Johor Bundled Biomass Steam Plant in Malaysia (UNFCCC, 2006e)	WT Speciality Ingredients Sdn. Bhd.	# 503
Mensilin Holdings Biomass Energy Plant Project (UNFCCC, 2007)	Mensilin Holdings Sdn. Bhd.	# 1214

ENCO Systems Sdn. Bhd. (ENCO) was prior to the field study period conferred in order to identify further possible technology relevant companies related to the abovementioned CDM projects[13]. On this basis, the Malaysian company Mensilin Holdings Sdn. Bhd. (see www.mensilin.com.my), which had been involved in preparing the design outlay and application of the technological system, and as the key investor in project #1214, was identified. Therefore, figure 4 below presents the constellation of companies that were considered relevant to include in further analysis.

Figure 4. Companies comprising case two.



As it appears from the above figure, the primary focus concerning this case, in relation to transfer of technology and knowledge from Annex 1 countries, concentrate on the activities of, including the interaction between, B & W Volund and ENCO. In this regard,

[13] Personal communication (email and telephone) with Mr. Ir. Chee Teck Hee from ENCO Systems Sdn. Bhd. during January 2007 concerning this issue.

a meeting with a representative from ENCO Systems Sdn. Bhd. was arranged early in the preparation of this thesis. Furthermore, the license & partner manager of B & W Volund, Mr. Peter Laursen, was contacted in order to perform an interview with a relevant representative of this company. Unfortunately, Mr. Laursen was not able to accommodate this request[14]. However, it was possible to arrange a meeting with Mr. Øjvind Toftgaard, who had been the managing director of B & W Volund during the period 1987–2003. It was considered that Mr. Toftgaard could provide relevant information regarding the history of the partnership between B & W Volund and ENCO. An appointment for an interview was furthermore arranged with the business development manager of the company Mensilin Holdings Sdn. Bhd. Mr. Faisal Abdul Rahman.

Since ENCO had been involved in several CDM projects in Malaysia, a variety of companies, and other CDM related stakeholders in the Malaysian context, was contacted in order to arrange visits to the CDM project sites and the relevant project host companies[15]. However, it was not possible to arrange meetings with two specific project host companies, located in the East Malaysian state of Sabah (on the island of Borneo), pertinent to the projects #395 and #402[16]. In addition, owing to problems related to visiting rules and regulations, a meeting arrangement could not be accommodated, during the field study period, with the companies hosting the projects #249 and #503[17]. It was moreover impracticable for ENCO to schedule a visit with the project host company relating to project #502 in this period. On this basis, the following assessment primarily concentrates on the projects #501 and #1214. The aforementioned projects will only be addressed in the analysis to the extent that these are relevant to discussions of the overall CDM related experiences of ENCO.

5.4.2. Technological systems implemented in the specific projects

The content and nature of the CDM projects #395 and #402 are identical in relation to the composition of the technological installations implemented. In these projects, EFB–residues from the palm oil industry are utilised in a biomass–fired cogeneration system in order to generate and supply both steam and electricity to two palm oil refineries located in East Malaysia (UNFCCC, 2006a, UNFCCC, 2006b). The project #249 is similar to these projects, although with a different usage of the steam generated (UNFCCC, 2005). In project #502, a fuel treatment boiler technology is implemented which enable already existing biomass–fired boilers, that supply steam to a industrial plant, to switch from utilising sawdust and mesocarp fibres to operate solely on EFB's (UNFCCC, 2006d). The project #503 concerns the installation of three biomass–fired boiler systems to supply steam to different industrial plants (UNFCCC, 2006e).

[14] Personal communication (email and telephone) with Mr. Peter Laursen during November 2007.
[15] Including personal communication (email and telephone) with Mr. Shahril Faizal Abdul Jani from the Malaysian DNA, Mrs. Stine Rabech Nielsen from the Danish Embassy in Malaysia and the Malaysian based consultants Mr. Henrik Rytter Jensen from the company Danish Energy Management and Mr. Søren Warming from the company SV Carbon Sdn. Bhd.
[16] Personal communication (email) with Mr. Daniel Koh King Hoon from the company Edible Oils Sdn. Bhd.
[17] Personal communication (email) with Mr. Henrik Rytter Jensen (see above) and Mr. Gareth Cheong from the company Wawasan Tebrau Sdn. Bhd.

In project #501, a biomass–fired (EFB's) cogeneration boiler system is implemented adjacent to a paper plant owned by the company Pascorp Paper Industries Berhad (the project host company) (UNFCCC, 2006c). The project activity is undertaken in two stages where steam, in the first phase, will be generated for the paper plant process consumption. In the second phase, the project will expand to meet the total steam requirements of the plant. The installation of a biomass fuel preparation plant, including a shredding and feeding system, is moreover associated with this project activity (Appendix 4). The project #1214 also involve the implementation of a biomass–fired cogeneration boiler system, although in this project activity, a range of other fuel input materials will be utilised, including bark, waste furniture, waste wood pallets and coffee waste (UNFCCC, 2007). Companies located within the Pasir Gudang Industrial Estate, in the south of Malaysia, will consume the steam generated by the boiler system. ENCO Systems Sdn. Bhd. will supply the boiler systems implemented in all of the abovementioned CDM projects. Unfortunately, in–depth information regarding these technological systems, in addition to what can be obtained from the PDD's, has not been accessible.

5.4.3. Analysis

The first interview of primary relevance regarding this case, was performed on March the 7th 2008 at the head office of ENCO Systems Sdn. Bhd. in Rawang (north of Kuala Lumpur). The interviewees included the managing director Mr. Allen L. C. Ng. and executive director Mr. Ir. Chee Teck Hee and the interview was undertaken in the presence of project engineers Mr. Ben Chin Hong Sing and Mr. Tsen Wee Yew. The topics of discussion, which are presented in Appendix 10, were send to Mr. Ir. Chee Teck Hee in advance of our meeting. Furthermore, the interview guide, which was also prepared beforehand, is given in Appendix 11. The analytical process underlying the main results presented in this section is accounted for in Appendix 12. An arrangement was moreover made, to accompany Mr. Ir. Chee Teck Hee on a visit to both the project implementation site and the fuel pre–treatment plant regarding the project #501 on the 22nd of March[18]. The second interview conducted, relevant to this case, was fore taken with Mr. Faisal Abdul Rahman, at the head office of the company Mensilin Holdings Sdn. Bhd., on March the 9th 2008, in Kuala Lumpur. This interview will be referred to as (Rahman, 2008) and the interview guide appertaining to this interview is appended in Appendix 13[19]. A visit to the project implementation site of the project #1214, in Johor Bahru (in southern peninsula Malaysia), was also arranged with Mr. Faisal Abdul Rahman to take place on the 25th of March 2008[20]. Finally, Mr. Øjvind Toftgaard was in

[18] In concrete terms, a delegation from a Singaporean company was inspecting the technological systems implemented in this CDM project. In this regard, it was possible for me to follow this group, and Mr. Ir. Chee Teck Hee, during their visit, which lasted the entire day.

[19] The topics of discussion, concerning the interview, were previously explained to Mr. Faisal Abdul Rahman via personal communication (email).

[20] During this visit, I followed Mr. Faisal Abdul Rahman and operations assistant Mr. Safarudin Abu Bakar, during an entire workday. The technological system had operational problems during this period. Therefore, the visit also included visiting local subcontracting companies involved in the project in order for Mr. Rahman to procure and order technological components.

relation to this case interviewed on the 11th of April 2008 at the head office of the company Acobio Sdn. Bhd. in Kuala Lumpur, where Mr. Toftgaard is currently the executive director. In Appendix 14, the interview guide regarding this interview is attached and in the following, the interview will be referred to as (Toftgaard, 2008)[21].

ENCO Systems Sdn. Bhd. was established in 1975 as an engineering company specialising in undertaking installation, service, and maintenance of boilers for varying companies deploying boiler technology systems in Malaysia (Appendix 12, http://www.enco.com.my/, 2008). In 1993, the company entered into a partnership agreement with the Danish company Danstoker A/S whereby ENCO was enabled to manufacture and install boiler systems on license terms. Since then, ENCO has produced a variety of Danstoker A/S boiler types, including oil–fired boilers, wood–fired steam boilers, hot water boilers, biomass fuel boilers and implemented these in various industries in Malaysia (Appendix 4). The license arrangement was approximately in 2003 changed into a royalty agreement, which still is in force, where royalties are paid per boiler manufactured (Appendix 12). In 1997, ENCO entered into a technology cooperation and royalty agreement with the Danish based company B & W Volund, with financial support from the Danish cooperation for environment and development programme (DANCED) (Ibsen et al., 2001)[22]. The objective of this arrangement was that ENCO, through cooperation with B & W Volund, would be enabled to manufacture and install boiler technologies that could utilise biomass residues from the Malaysian palm oil industry (http://www2.mst.dk/, 2008). In this regard, B & W Volund specially designed a biomass boiler system, based on the company's long experience with design and development of boiler technologies (Toftgaard, 2008 Appendix 12, see also http://www.volund.dk/, 2008). From the initiation of this arrangement, including implementation of the first boilers, ENCO played an active role in continuously developing and optimising the system further and thereby, inter alia, gained comprehensive insights into the system[23]. Therefore, during this process of collaboration, following the initial years, ENCO became capable of undertaking manufacture and implementation of the boiler system independently of B & W Volund (Appendix 12, Toftgaard, 2008).

In relation to the initial B & W Volund design of the boiler system, ENCO has subsequently undertaken incremental (re)design, and manufactured parts of, the technological systems that surround the core components in the boiler system (Appendix 12). The core components, which were designed by B & W Volund, include the

[21] The topics of discussion, concerning the interview, were previously explained to Mr. Toftgaard via personal communication (email).
[22] Background information regarding both B & W Volund and Danstoker A/S needs to briefly be clarified here. During the period 1978–2000, Danstoker A/S was a subsidiary company of the Danish based Volund Ansaldo Group (http://www.danstoker.dk/, 2008). In 2003, the Volund Ansaldo Group was overtaken by the American company Babcock & Wilcox and the Volund Group have since then been named Babcock & Wilcox Volund (http://www.volund.dk/, 2008).
[23] At the outset of the partnership, ENCO employees also visited B & W Volund in Denmark and where trained in the design and boiler technology (Ibsen et al., 2001). ENCO moreover received comprehensive set of technical drawings, manuals and all necessary specific information to manufacture and implement the boiler system.

combustion system; the grate, pressure parts, the furnace, etc., and the elements designed by ENCO comprise the fuel pre–treatment system, the fuel feeding system and the final material processing system (Appendix 4). As a company, ENCO has on this background gradually developed from undertaking boiler service and maintenance related activities to manufacture and implementing complete boiler systems through partnership arrangements with the Danish based companies. ENCO has in this regard, to date sold over 300 boilers, and these have been deployed both in Malaysia and in various countries in the South East Asian region (http://www.cogen3.net/, 2008, Appendix 4 & 12). ENCO is currently also engaged in manufacturing, under license agreements, several technology subcomponents, which are included in the complete boiler system, including burners, fans, etc. (Appendix 4, Toftgaard, 2008, see also www.enco.com.my).

Regarding the CDM related activities of ENCO in Malaysia, the company has manufactured and implemented both Danstoker A/S, and B & W Volund boiler types, under royalty agreements, and has therefore operated through pre–existing channels of technology and knowledge transfer[24]. Therefore, in reference to chapter 4, the project related internal arrangement, pertinent to the specific projects in this case, is therefore equivalent to the third categorical type of internal arrangements. In continuation hereof, CDM have established channels to the technology end users in the projects. During the visit to the plant site of project #501, it could also be observed that a range of technological hardware components, originating from a variety of companies based in different countries, was integrated in the complete system[25]. In relation to project #1214, the end users of the boiler technology, and therefore the project host company, were employees of the project owner company Mensilin Holdings Sdn. Bhd. Furthermore, it was clear from the visit to the project site of project #1214, that a number of both local companies and non–Malaysian companies were involved in providing technological hardware components to the project[26].

It seems evident that ENCO was capable of undertaking manufacture and implementation of Danstoker A/S and B & W Volund type boiler technologies independently before the company's involvement in CDM projects. Although a technology cooperation agreement exist between ENCO and B & W Volund, beside the royalty agreement, it also appears that B & W Volund has not been involved in the implementation of boiler systems in Malaysian CDM projects (Appendix 12, Toftgaard, 2008)[27]. ENCO has thus been responsible for implementing these systems, including handling and overcoming the technological challenges (or barriers) in the CDM projects in this context (Rahman, 2008). In this regard, it is held in all the PDD's related to this case that there exist technological barriers, especially associated with utilising EFB's, which renders the projects unlikely to be undertaken in the absence of the CDM (see UNFCCC, 2006c

[24] It has unfortunately not been possible, due to the limited technical information available, to identify which projects involve implementation of either Danstoker A/S or B & W Volund type of boilers.
[25] These companies included Barker Jørgensen A/S (www.barker.dk), Vecoplan (www.vecoplan.com), Andritz Sprout A/S (www.andritz.com), Fredrik Mogensen AB (www.mogensen.se), and others.
[26] These encompassed, e.g. the companies Tractors Malaysia Sdn. Bhd. (www.tractors.com.my), San-Ichi Technology (Asia Pacific) Sdn. Bhd., Elliot Company (www.elliott-turbo.com), etc.
[27] This was also evident from personal communication (email and telephone) with Mr. Peter Laursen (from B & W Volund).

UNFCCC, 2007, etc.). These obstacles and challenges have necessitated further adjustment and development of the technological subsystems surrounding the core components of the boiler system, especially the fuel pre–treatment system (Appendix 4). On this basis, ENCO has through its CDM project involvement continued its standard activities, which encompass application of boiler systems, including continuously optimising the technological subsystems. In relation hereto, it appears that the CDM related revenue stream (CER's) is considered by ENCO to render projects more financially viable, which allow the company to venture into further projects (Appendix 12). It needs also to be mentioned that the PDD's and validation reports pertaining to the projects addressed in this case apply the almost exact same formulation regarding technology and knowledge transfer. The argument put forward concern that since ENCO manufacture a boiler system originally designed by B & W Volund this circumstance implicitly facilitate technology and knowledge transfer (see e.g. UNFCCC, 2006c, UNFCCC, 2006e, UNFCCC, 2007).

Concerning both projects #501 and #1214, the objective of the training activities conducted by ENCO have been limited to enable the respective operators to undertake efficient operation and maintenance of the boiler system (Rahman, 2008). In relation to the project #501, it could also be observed during the visit to the project site, that ENCO practiced a very restrictive visitor policy to hinder local and other companies from gaining insights into the implemented systems.

As a consultancy company, and project owner, Mensilin Holdings Sdn. Bhd. has planned and designed the overall system regarding project #1214, which encompass procurement and arrangement of the larger technological components, e.g. biomass boiler systems, steam turbines, etc., according to the specific requirements in the project (Ibid.). Since the company has specialised in and has extensive experience within this field, including prior involvement in application of boiler systems supplied by ENCO (see www.mensilin.com.my, http://www.cogen3.net/, 2008), the technological learning to implement these boiler systems is considered limited (Rahman, 2008).

5.4.4. Key findings

In this case, the primary focus concerns the CDM related activities in Malaysia of the Malaysian company ENCO Systems Sdn. Bhd. and in this context also address the relationship and interrelation with its affiliated Danish based companies Danstoker A/S and B & W Volund. The CDM projects #501 and #1214 and the related project host companies have moreover been taken into consideration. Based on the assessment above, it seems evident that ENCO was capable of undertaking production and implementation of both Danstoker A/S and B & W Volund type of boiler systems prior to the company's involvement in CDM projects. ENCO has in addition, independently and continuously, undertaken incremental improvement of the technological subsystems in order to overcome the technological barriers in the CDM projects. In this regard, the CDM has initiated further applications of these boiler systems in Malaysia. The training undertaken of the project host companies have been limited to enable the respective employees to operate and maintain the boiler systems efficiently. On this basis, CDM has played a limited role to facilitate transfer of technological knowledge and thereby increase the level of technological capability of the Malaysian companies involved in this case. It appears however that a range of technological hardware components, included in the case–related projects, have been sourced from different countries including Germany, Denmark, USA, Sweden, etc., as well as from local subcontracting companies.

References – case two

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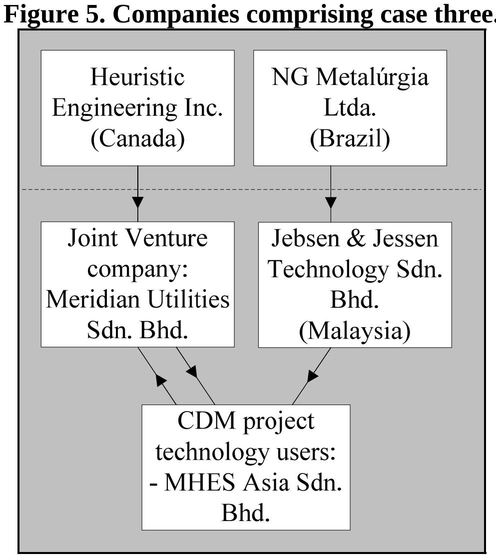
5.5. Case three – Heuristic Engineering Inc. and MHES Asia Sdn. Bhd., and Jebsen & Jessen Technology Sdn. Bhd. and NG Metalúrgica Ltda.

5.5.1. Identification of the actors and projects addressed in this case

From the initial assessment of the PDD's taken into consideration in this thesis, the Canadian company Heuristic Engineering Inc. and the Brazilian company NG Metalúrgica Ltda. were both identified as technology providers to one registered CDM project in Malaysia. This specific project was referred to as the Bandar Baru Serting Biomass Project (CDM project No. 1091) (UNFCCC, 2007). The Malaysian company MHES Asia Sdn. Bhd. was furthermore stated in the PDD, as the project host company and project owner regarding this project activity.

In order to assess whether additional companies had been involved in the technology related aspects of this CDM project, NG Metalúrgica Ltda. and Heuristic Engineering Inc. was consulted before the field study period[28]. Following this, the Malaysian based company Jebsen & Jessen Technology Sdn. Bhd., which has been involved as an intermediary partner of NG Metalúrgica Ltda. in supplying technology components to the project, was identified. In addition, the joint venture company between Heuristic Engineering Inc. and MHES Asia Sdn. Bhd., Meridian Utilities Sdn. Bhd., was moreover recognised as relevant to take into consideration. On this basis, the companies considered relevant to be included in further analysis, is presented in the figure 5 below.

Figure 5. Companies comprising case three.



As indicated in the above figure, the primary focus area in relation to this case concerns the activities of Heuristic Engineering Inc. and MHES Asia Sdn. Bhd., including the relationship and interaction between these companies, through their joint venture company Meridian Utilities Sdn. Bhd. (as suggested by the arrows). In this regard, an

[28] Personal communication (telephone) with Mr. Mr. Benedito Carlos Stollai from NG Metalúrgica Ltda. (on the 23rd of November 2007) and Mr. Malcolm Lefcort from Heuristic Engineering Inc. (during February 2008) concerning this issue.

appointment was arranged for a telephone interview with the engineering manager of Heuristic Engineering Inc. Mr. Malcolm Lefcort. During the preparation of this thesis, it was unfortunately not possible to arrange neither a telephone interview nor a meeting with a representative from MHES Asia Sdn. Bhd. before, during, or after the field study period[29].

A secondary focus area pertaining to this case, concern the activities of the companies Jebsen & Jessen Technology Sdn. Bhd. and NG Metalúrgica Ltda. Therefore, a meeting for an interview was arranged with the senior manager of Jebsen & Jessen Technology Sdn. Bhd. Mr. Albert Cheong. It was considered that Mr. Cheong would also be able to provide valuable information concerning the various companies involved in the technological aspects of the project, the progression of the project activity, and more. A telephone interview was furthermore scheduled with the export sales manager from NG Metalúrgica Ltda. Mr. Benedito Carlos Stollai. Although Brazil is a Non Annex 1 country party to the Kyoto protocol, it was considered relevant to include NG Metalúrgica Ltda. in the analysis, inter alia, because the company's involvement appeared from the PDD to facilitate transfer of technology to Malaysia (UNFCCC, 2007, http://cdm.unfccc.int/, 2008).

5.5.2. Technological systems implemented in the specific project

The technological nature of project #1091 involves the implementation of a biomass (EFB's) fired electricity generation plant with a total capacity of 13 MW (UNFCCC, 2007). The electricity generated from the project activity will be supplied to the national grid. A range of subsystems, including a two–stage wet combustor technology, turbo alternator, heat recovery system, steam turbine, etc., comprise the core components of the complete system (Ibid., Appendix 18). Heuristic Engineering Inc. will supply the combustion (gasification) system, the so–called Envirocycler technology (see http://www.heuristicengineering.com/, 2008b), and NG Metalúrgica Ltda. provides the steam turbine (see www.ngmetalurgica.com.br).

5.5.3. Analysis

The first interview conducted of relevance to this case was undertaken with Mr. Malcolm Lefcort on the 27th of February 2008 and the interview will in the following be referred to as (Lefcort, 2008). The interview guide prepared in advance of this interview is provided in Appendix 15[30]. Since it was not possible to interview a representative from MHES Asia Sdn. Bhd., a comprehensive understanding of the background, development, activities, partnership arrangements, the CDM project involvement, etc., regarding this company, was therefore unattainable[31]. Sufficiently detailed data–material have therefore

[29] Personal communication (email and telephone) with Mr. Hazari and the company director Mr. Pillay T. K. Panjalingam of MHES Sdn. Bhd. during the period from December 2007 to May 2008.

[30] The topics of discussion, concerning the interview, were previously explained to Mr. Lefcort via personal communication (email).

[31] It has in this regard proven very difficult to obtain information regarding this company, especially concerning its CDM project involvement. Different Malaysian CDM related stakeholders have during the preparation of this thesis been contacted in order to attain further information. Including personal

not been available in order to prepare a matrix describing the analytical coding and interpretation process, as presented in the previous sub–cases, in relation to this company.

The second interview relevant to this case was performed on March the 5th at the head office of Jebsen & Jessen Technology Sdn. Bhd. in Kuala Lumpur with Mr. Albert Cheong. The topics of discussion, the interview guide, and the analytical coding and interpretation process concerning this interview are provided in Appendix 16, 17 & 18. Preceding this interview, a telephone interview was carried out on the 23rd of November 2007, with Mr. Benedito Carlos Stollai. The interview is referred to as (Stollai, 2007) and in Appendix 19, the interview guide pertinent to this interview is appended.

The following assessment will first (and foremost) address the relationship and interaction between Heuristic Engineering Inc. and MHES Asia Sdn. Bhd. and subsequently focus on Jebsen & Jessen Technology Sdn. Bhd. and NG Metalúrgica Ltda.

5.5.3.1. Heuristic Engineering Inc. and MHES Asia Sdn. Bhd.

Heuristic Engineering Inc. has since 1980 specialised in the development and application of combustion system technologies, which utilise various (waste) biomass input fuel materials in order to capture and generate energy (http://www.heuristicengineering.com/, 2008a). The company has a license agreement with the Canadian company Northern Steel Ltd. (see www.northernsteelltd.com) to manufacture the main combustion system product of Heuristic Engineering Inc., the patented Envirocycler technology (Lefcort, 2008). In 2004, Heuristic Engineering Inc. ventured into a joint venture company called Meridian Utilities Sdn. Bhd. with MHES Asia Sdn. Bhd. and Northern Steel Ltd. The purpose was, through this Malaysian based company, to jointly undertake promotion, marketing, manufacturing, and distribution of the Envirocycler technology in Malaysia and the region (Heuristic Engineering Inc., 2004)[32]. This arrangement, which was not intended to focus specifically on CDM projects, laid the ground for a close and mutually benefiting cooperation agreement between the three parties involved. The contractual obligations of Heuristic Engineering Inc. was in this regard, inter alia, to provide and transfer comprehensive information regarding the technology, including all rights and privileges, process outlay, technical drawings, designs, know–how, data, perform training activities, etc. to Meridian Utilities Sdn. Bhd (Ibid.). MHES Asia Sdn. Bhd. was obliged to assist Meridian Utilities Sdn. Bhd. with performing market feasibility studies, obtain customer application requirements, including information on fuel type, site details, etc., perform sales and service, and more. The responsibility of Northern Steel Ltd. was to manufacture all components related to the complete Envirocycler system and in this regard procure any necessary subcomponents. Over time, the intention was that Meridian Utilities Sdn. Bhd. would become able to operate and undertake implementation of the

communication (email and telephone) with Mr. Shahril Faizal Abdul Jani from the Malaysian DNA, Mrs. Rasidah Sulaiman from the Malaysian Energy Information centre, and Mr. Albert Cheong from Jebsen & Jessen Technology Sdn. Bhd.

[32] The joint venture company was to have a board of directors consisting of six directors of whom 4 would be appointed by MHES Asia Sdn. Bhd. and 2 would be nominated by Heuristic Engineering Inc. (Heuristic Engineering Inc., 2004).

Envirocycler technology, including procurement of components, manufacturing, etc., independently of the Canadian partners (Lefcort, 2008).

At the outset of the joint venture partnership, Heuristic Engineering Inc. transferred the general arrangement drawings of the Envirocycler technology, describing the overall conceptual outlay of the installations, although without detailed information regarding the dimensions etc., to MHES Asia Sdn. Bhd. (Lefcort, 2008, Appendix 18). Subsequently to the commencement of Meridian Utilities Sdn. Bhd., it seems evident however that there has been an absence of any kind of communicative, technological, and financial interaction between the two Canadian companies on the one hand and MHES Asia Sdn. Bhd. on the other hand (Lefcort, 2008). In this regard, there have also not been transferred technological hardware components from the Canadian manufacturer to neither the joint venture company nor MHES Asia Sdn. Bhd., although agreed upon so in the contract (Ibid., Heuristic Engineering Inc., 2004). It seems therefore that the parties in the joint venture partnership have not complied with the contractual requirements concerning collaboration issues, rights and privileges, etc.

Despite the scarcity of information regarding the activities of MHES Asia Sdn. Bhd., it appears that the principal business activity of the company is to carry out development, operation, and management of small power generation plants in Malaysia (Appendix 4). The company has in this regard been involved in various projects, since its commencement in 1982, concerning implementation of different technologies, which utilise biomass from the Malaysian palm oil industry to generate energy (http://www.biogen.org./, 2007, UNDP, 2007, Appendix 4 & 18). This indicate that the company, prior to the possibility of participating in CDM projects, have attained previous experiences within this field.

In relation to the CDM project involvement of MHES Asia Sdn. Bhd. in Malaysia, there is evidence suggesting that the Envirocycler technology has been implemented in relation to project #1091 (Appendix 18, http://cdm.unfccc.int/, 2008). In this regard, the CDM utilise pre–existing channels of technology and knowledge transfer, through the joint venture partnership. The project related internal arrangement pertinent to project #1091, concerning these companies, is therefore cf. chapter 4, equivalent to the first categorical type of internal arrangement. It nevertheless also seems evident, that MHES Asia Sdn. Bhd. independently of Heuristic Engineering Inc. and Northern Steel Ltd. successfully has installed the Envirocycler technology based on the initially transferred technical drawings and has subcontracted fabrication of the components comprising the system, e.g. from local Malaysian companies (Appendix 18). In this regard, MHES Asia Sdn. Bhd. has apparently during the implementation of this CDM project independently handled and overcome the technological challenges and barriers pertaining to the utilisation of EFB's in the Envirocycler technology (Ibid., UNFCCC, 2007). The technological learning through the CDM project involvement to MHES Asia Sdn. Bhd., or Meridian Utilities Sdn. Bhd., is therefore not facilitated through continuous interrelation between the companies involved in this case, but rather confined to transfer of codified technological knowledge embodied in the technical drawings (see chapter 4, section 4.2.1.). Beside the procurement of technological components, and other installations, from Malaysian subcontractors, it also appears that a range of technological hardware components included in the project has been acquired from other countries in the region (Appendix 18). It needs to be mentioned that technology transfer has been formulated in short and imprecise terms in the PDD pertaining to this project and claimed since Heuristic Engineering Inc. will provide the combustions system (UNFCCC, 2007).

5.5.3.2. Jebsen & Jessen Technology Sdn. Bhd. and NG Metalúrgica Ltda.

Jebsen & Jessen Technology Sdn. Bhd. is a corporation spanning worldwide with a range of subsidiaries, partnership arrangements, business activities, etc., in various countries, and has existed in Malaysia since the 1960’s (Appendix 4). Under one of the company’s seven strategically core business activities, the technology unit, Jebsen & Jessen Technology Sdn. Bhd. has supplied and implemented varying turbine systems in Malaysia for different companies through partnership arrangements (Appendix 18, www.technology.jjsea.com). This business unit has developed from undertaking sales, installation, and service regarding these turbine technologies to increasingly design and implement complete power generation plants, including supplying all technological subcomponents through partnership arrangements and/or regional procurement (Appendix 18). In total, the company has implemented around 600 turbines in various industries in Malaysia and the South East Asian region. In this context, Jebsen & Jessen Technology Sdn. Bhd. has accumulated comprehensive insights into installation and development of power generation plants, including experiences from participation in projects that involve utilisation of biomass waste material from the Malaysian palm oil industry (http://www.cogen3.net/, 2008, Appendix 18).

Since the early 1990’s, Jebsen & Jessen Technology Sdn. Bhd. has under a partnership agreement been authorised to undertake sale, installation and service of varying turbine systems in Malaysia for the Brazilian turbine manufacturer company NG Metalúrgica Ltda. (Stollai, 2007, Appendix, 18). In concrete terms, the manufacturer delivers the turbine, i.e. sends the technological hardware according to specific application requirements, and Jebsen & Jessen Technology Sdn. Bhd. conducts all aspects related to the implementation. NG Metalúrgica Ltda. therefore plays a very limited role in the concrete project installations (Stollai, 2007). This procedure has continued under the project #1091 and the implementation of the turbine technology has in this regard operated through pre–established channels of technology and knowledge transfer. The project related internal arrangement, in relation to these companies, is therefore also equivalent to the first categorical type of arrangement. In continuation, it seems evident that Jebsen & Jessen Technology Sdn. Bhd., before the company’s involvement in project #1091 and other CDM projects, was capable of undertaking implementation of NG Metalúrgica Ltda. turbine systems, including applications of these in power generation plants involving the utilisation of EFB’s (Appendix 18). Jebsen & Jessen Technology Sdn. Bhd has thereby during its CDM project involvement, furthered the standard activities of the company through application of turbine systems in Malaysia. The company has in this regard also undertaken training of the relevant operators of the turbine system implemented in the project in order to secure efficient maintenance and operation of the technology.

5.5.4. Key findings

The primary focus in relation to this case concerned the activities of, including the interaction between, the companies Heuristic Engineering Inc. and MHES Asia Sdn. Bhd. in relation to project #1091. Unfortunately, there was not sufficient available information to carry out an assessment of the background of MHES Asia Sdn. Bhd., the company’s business activities, CDM project involvement, and more. A comprehensive understanding of what the CDM, seen in a historic context, entailed for the ability of the company to manufacture, operate, implement, or develop similar technological components, systems, complete projects, etc., as pertaining to project #1091, was therefore not obtainable. Therefore, it was not possible to account for, in further detail, what role the CDM played, through technology and knowledge transfer, in relation to increase the level of technological capability of MHES Asia Sdn. Bhd. It seems however, that MHES Asia Sdn. Bhd., prior to its involvement in this CDM project, received technical drawings displaying the general configuration of the Envirocycler technology, which enabled the company to carry out successful implementation of the system in the project. This finding was nevertheless not substantiated by a representative of MHES Asia Sdn. Bhd. Lastly, it appears that the absence of interrelation or collaboration between MHES Asia Sdn. Bhd. and Heuristic Engineering Inc., in relation to and throughout implementation of project #1091, hindered a more substantial technological learning process.

A secondary area of interest regarding this case, concerned the activities of the Malaysian company Jebsen & Jessen Technology Sdn. Bhd. and its Brazilian affiliate company NG Metalúrgica Ltda. Jebsen & Jessen Technology Sdn. Bhd. has under a sales and service agreement provided and implemented turbine systems, manufactured by NG Metalúrgica Ltda., in Malaysia since the early 1990’s. These activities, which also involve adjustment of the turbine according to specific application requirements, continued in relation to project #1091. This implies that technological hardware components were transferred, both in relation to the involvement of these companies, and in relation to others, regarding project #1091. However, it seems evident that the CDM did not contribute to increase the level of technological capabilities of Jebsen & Jessen Technology Sdn. Bhd. The technological learning impact was therefore limited to enable the operators to carry out efficient operation and maintenance of the turbine.

References – case three

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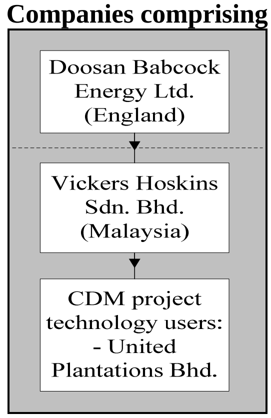
5.6. Case four – Vickers Hoskins Sdn. Bhd. and Doosan Babcock Energy Ltd.

5.6.1. Identification of the actors and projects addressed in this case

It was not possible to identify a technology provider in the PDD pertaining to the registered CDM project No. 558, referred to as Jendarata Steam and Power Plant, based on the initially undertaken assessment (UNFCCC, 2006a). However, the project–related validation report established the Malaysian company Vickers Hoskins Sdn. Bhd. as the technology provider under an unspecified affiliate arrangement with a UK based company (UNFCCC, 2006b). The project owner and the project host company were both identified United Plantations Bhd. (UNFCCC, 2006a, see also www.unitedplantations.com).

A representative from Vickers Hoskins Sdn. Bhd. was before the field study period consulted in order to attain information regarding the potential participation of other companies relevant to the implemented technologies[33]. Following this, the abovementioned UK based company was identified as Doosan Babcock Energy Ltd. (see www.doosanbabcock.com) and this company was therefore taken into consideration. On this basis, the companies, and the constellation of these, considered relevant to include in further analysis is presented in figure 6 below.

Figure 6. Companies comprising case four.



As is evident from the figure above, the focus in relation to this case concentrate on the activities of, and interaction between, the companies Doosan Babcock Energy Ltd. and Vickers Hoskins Sdn. Bhd. in relation to project #558. In this regard, a meeting for an interview was arranged with the manager of the finance division of Vickers Hoskins Sdn. Bhd. Mr. Low Yong Heng. Unfortunately, it was not possible to schedule an appointment with a representative from Doosan Babcock Energy Ltd., in order to perform a telephone interview, since it is the policy of the company to refrain from participating in any kind of studies or research undertakings[34]. Lastly, an arrangement for a telephone interview was made with the vice chairman & executive director of United Plantations Bhd. Mr.

[33] Personal communication (email and telephone) with Mr. Low Yong Heng from Vickers Hoskins Sdn. Bhd. during January 2008 concerning this issue.
[34] Personal communication (email and telephone) with Mrs. Lesley Lambert from Doosan Babcock Energy Ltd. during January 2008 concerning this issue.

Carl Bek Nielsen. It was however, during the field stud period, not possible to visit the project site owing to the visiting rules and regulations of the project host company.

5.6.2. Technological systems implemented in the specific project

Project #558 concerns the replacement of existing and low efficient biomass fired fire–tube boilers with more efficient water–tube biomass reciprocating grade boiler at the Jendarata palm oil mill, owned by United Plantations Bhd. (UNFCCC, 2006a). The implemented boiler system concerns the so–called Bi Drum Water Tube Boiler, which comprise e.g. a reciprocal grade furnace that increases the efficiency of the combustion process (UNFCCC, 2006b, Appendix 4). In this regard, the new high efficiency boiler system will generate more steam per unit of fuel input compared to the existing installations. In addition, a new 2 MW steam turbine will also be installed, which will enhance the electricity generating capacity by utilising the high–pressure steam from the new boiler system. The increased efficiency of the new boiler system will generate steam and electricity to meet the in–house energy demand of the palm oil mill, but will also allow the palm oil mill to export surplus steam and electricity to the neighbouring Unitata palm oil refinery, which is a sister company of United Plantations Bhd. (UNFCCC, 2006b). In the refinery, this input of steam and electricity will contribute to meet some of the energy demand of the plant. The new boiler system will primarily utilise EFB's as biomass input fuel.

5.6.3. Analysis

The first (telephone) interview conducted with relevance to this case was performed on the 29th of February 2008 with Mr. Carl Bek Nielsen, which in the following will be referred to as (Nielsen, 2008). The topics of discussion and the questions guiding the interview are appended in Appendix 20 and 21. Furthermore, an interview was undertaken with Mr. Low Yong Heng on March the 24th 2008 at the head office of Vickers Hoskins Sdn. Bhd. in Kuala Lumpur. The interview guide and the coding and interpretation process are given in Appendix 22 and 23[35].

Vickers Hoskins Sdn. Bhd. was formed in 1978 as a company specialising in the production of biomass fuel fired boilers to be utilised primarily in the Malaysian palm oil mills (http://www.vickershoskins.com/, 2008a). Since then, the company has manufactured, installed, and commissioned over 800 boilers in Malaysia and in the South East Asian region and therefore hold an entrenched position and an extensive share of the market for biomass–fired boilers (http://www.ram.com.my/, 2005, Appendix 4). Vickers Hoskins Sdn. Bhd. manufactures a range of primarily steam generating boiler systems and in this regard undertakes various service and consultancy related activities as well. The applications of the boilers has, since the initiation of the company, spanned over a wide range of industries and include power generation plants, pharmaceutical sector, food processing industry, wood manufacturing, and district cooling plants (Appendix 4). Furthermore, the company produce several auxiliary technologies, related to boiler

[35] The topics of discussion, concerning the interview, were previously explained to Mr. Low Yong Heng via personal communication (email).

systems, including air pre–heaters, dust arrestors, fuel oil pre–heaters, soot–blowers, furnace stokers, super heaters, and economizers (http://www.vickershoskins.com/, 2008b).

In 1980, Vickers Hoskins Sdn. Bhd. entered into a partnership arrangement with the UK based company Doosan Babcock Energy Ltd., which entailed to manufacture boiler systems under a license agreement (http://www.vickershoskins.com/, 2008a, Appendix 23). Doosan Babcock Energy Ltd. is a globally leading company specialising in energy services and operate in various countries in thermal power, nuclear, petrochemical, oil & gas and pharmaceutical industries (http://www.doosanbabcock.com/, 2007). The company has since 1891 also been a leading company in developing steam generation systems including design and engineering of boiler systems as one of its core business activities (http://www.doosanbabcock.com/, 2008). Doosan Babcock Energy Ltd. initially designed a boiler system, which could utilise various biomass input materials according to different application requirements in Malaysia. The license agreement between the companies has since its commencement involved that Vickers Hoskins Sdn. Bhd. pays a license fee for every boiler produced (Appendix 23).

Vickers Hoskins Sdn. Bhd. has independently undertaken manufacture and implementation of this standard type of boiler system, predominantly in the palm oil industry, including performing minor adjustments and modifications. However, it appears that in specific applications where the challenges have been more substantial, i.e. which have necessitated certain design and outlay configuration rearrangements, the engineering department team of Vickers Hoskins Sdn. Bhd. has consulted the technical office of Doosan Babcock Energy Ltd. (Ibid.). During a process of interaction between the companies, employees of Vickers Hoskins Sdn. Bhd. have initially proposed and presented the necessary design outlay alternations to the technical office employees of Doosan Babcock Energy Ltd.[36]. This office has subsequently provided advice, control, and detailed technical calculations, concerning these initial proposals, although through a process of close collaboration between the companies, in order to solve the challenges and optimise the system in these specific projects. This procedure has been standard practice between the companies since the initiation of the partnership[37] (Ibid., see also http://www.cogen3.net/, 1997). In addition, employees of Vickers Hoskins Sdn. Bhd. have frequently received in–house training, at Doosan Babcock Energy Ltd. offices, through participating in courses concerning advancement of new designs and thermal calculation undertakings (Appendix 23).

Vickers Hoskins Sdn. Bhd. has thus far only been involved in one registered CDM project (project #558) and in this project, the company provided the boiler, under the license agreement with Doosan Babcock Energy Ltd. The CDM has in this regard operated through pre–established channels of technology and knowledge transfer. The project related internal arrangement is therefore equivalent to the third categorical type

[36] The contractual agreement between the companies has unfortunately not been attainable during the preparation of this thesis. This could possibly have contributed to a greater understanding of the companies' respective obligations concerning this collaboration process.
[37] This has however not been substantiated by an employee of Doosan Babcock Energy Ltd.

(cf. chapter 4). It needs to be mentioned that Vickers Hoskins Sdn. Bhd. consider the CDM related CER revenue as an important element, which increase the financial viability of the project and accordingly the company's interest and participation (Appendix 23). In concrete terms, it seems that project #558 necessitated a redesign of the standard boiler system in order to utilise EFB's in the combustion process and thereby to overcome the associated fuel related technological barriers (Appendix 23, see also E. consulting & M. Holdings, 2006, UNFCCC, 2006a). Therefore, the interaction between the companies proceeded as explained above, although Vickers Hoskins Sdn. Bhd. also performed incremental improvements, e.g. regarding the grate system, independently of Doosan Babcock Energy Ltd. The technical office of Doosan Babcock Energy Ltd. thus provided its expertise regarding the reconfiguration and complete (modified) outlay of the complex and integrated boiler system (Appendix 23). Through this process, Vickers Hoskins Sdn. Bhd. became enabled to independently carry out implementation of this specific system in future projects, including undertaking minor adaptations. However, it also appears that this technological learning process is to be understood in a historic context as well, which in this regard continues the previous activities and nature of the partnership, interaction, and collaboration between the companies (see http://www.ram.com.my/, 2005). Vickers Hoskins Sdn. Bhd. furthermore carried out training activities of the relevant operators at the plant in order to enable these to perform efficient operation and maintenance of the boiler system, although the project host company also played an active role in the final implementation of the complete system in project #558 (Nielsen, 2008, Appendix 23).

Lastly, it appears that a range of technological hardware components, originating from a variety of countries all over the world, have been integrated in the complete system. These include a generator, various components incorporated in the boiler system, components procured from Malaysian subcontracting companies, e.g. the fuel pre–treatment system, and more. The steam turbine was supplied by Jebsen & Jessen Technology Sdn. Bhd., which most likely, was manufactured by NG Metalúrgica Ltda. (Appendix 23, see also case three).

5.6.4. Key findings

This case concerns the activities of, including the interaction between, the Malaysian company Vickers Hoskins Sdn. Bhd. and the UK based company Doosan Babcock Energy Ltd. in relation to CDM project #558. It seems evident that Vickers Hoskins Sdn. Bhd. independently in numerous cases, since 1980, has manufactured and implemented the standard boiler system originally designed by Doosan Babcock Energy Ltd., in Malaysia and the region. Furthermore, it appears that in certain projects, which requires a more substantial reconfiguration and redesign of the basic boiler system outlay, the companies have interacted through close collaboration and Doosan Babcock Energy Ltd. has provided its expertise concerning engineering design. This procedure continued in relation to project #558 and Vickers Hoskins Sdn. Bhd. thereby utilised the expertise of the licensee holder to overcome the challenges, or technological barriers, associated with utilising EFB's in the boiler system. The technological learning during this process therefore enabled Vickers Hoskins Sdn. Bhd., in a narrow sense, to implement this specific rearranged boiler system in future projects, and in this regard contributed to increase the capability of the company, as a whole, to undertake the necessary adjustments independently of Doosan Babcock Energy Ltd. It nevertheless seems clear that the nature and content of the interaction between the two companies, throughout their involvement in project #558, was a continuation of the standard procedure that has taken place since the commencement of the license partnership in relation to specific projects. Lastly, the main technological hardware components implemented in this project activity, include the combustion system and the steam turbine, which most likely originate from the Brazilian company NG Metalúrgica Ltda.

References – case four

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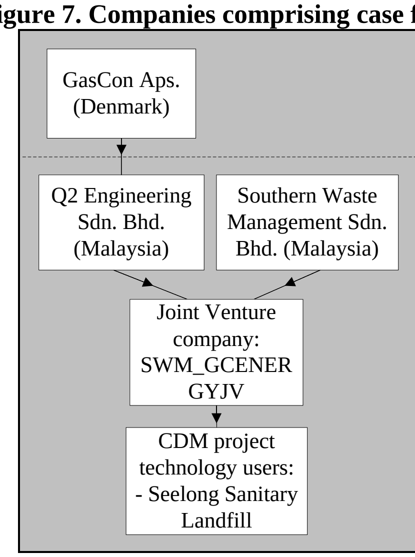
5.7. Case five – GasCon Aps. and Southern Waste Management Sdn. Bhd.

5.7.1. Identification of the actors and projects addressed in this case

The initially performed assessment of the PDD's taken into consideration in this thesis established the Danish company GasCon Aps. as the technology provider, under a partnership agreement with the Malaysian project owner company Southern Waste Management Sdn. Bhd. (SWM), to one registered CDM project in Malaysia. This project was referred to as the Landfill Gas utilization at Seelong Sanitary Landfill project (CDM project No. 927) (UNFCCC, 2007). The project host company was identified as the Seelong Sanitary Landfill.

GasCon Aps. was at the outset of preparing this thesis consulted in order to identify other relevant companies involved in the technology related aspects regarding this specific CDM project[38]. The Malaysian based subsidiary company of GasCon Aps., Q2 Engineering Sdn. Bhd., was on this basis recognised as a key actor in this context, and was therefore taken into consideration as well. In summation therefore, figure 7 below, provide an overview of the companies, and the constellation of these, identified as relevant to be included in further analysis.

Figure 7. Companies comprising case five.



As it appears from the above figure, the focus of this case concerns the activities of the companies GasCon Aps., Q2 Engineering Sdn. Bhd., and Southern Waste Management Sdn. Bhd., including the relationship and interaction between these companies, through a joint venture company, concerning project #927. In this regard, a telephone interview was arranged with the chief executive officer of GasCon Aps. Mr. Frans Teisen. Furthermore, a meeting was scheduled with the project manager of Q2 Engineering Sdn. Bhd., Mr. Low King Hserng, in order to perform an interview with a relevant representative of this company. Mr. Hserng was also a former employee of SWM (between 1999–2006) and

[38] Personal communication (telephone) during November 2007 with Mr. Frans Teisen from GasCon Aps.

could therefore provide valuable information regarding this company. Finally, an appointment for an interview was arranged with the project engineer of SWM Mr. Koay Chuen Hoe. Since SWM operate as the concessionaire of Seelong Sanitary Landfill, an interview with Mr. Hoe was furthermore considered appropriate in order to gain insight into the CDM related experiences of the local employees at the Landfill. SWM was also involved in the CDM project #323 but, as mentioned earlier, this project was precluded from the analysis in the initial phase of preparing this thesis (see chapter 3) and the following assessment will therefore only address project #927[39].

5.7.2. Technological systems implemented in the specific project

The technological nature and content of this project activity concern the implementation of a landfill gas recovery system (at the Seelong Sanitary Landfill), comprising three core subsystems, which will capture, flare and utilise methane emissions from the landfill to generate energy (UNFCCC, 2007). The stepwise process of collecting and utilising the methane gas reflects the three technological subsystems involved in the project (Pedersen, 2008). In the initial stage of the process, the landfill gas recovery system, consisting of a series of vertical wells inserted with perforated pipes, will collect the gas. Subsequently, the gas will be transported to a gas pumping station comprising e.g. a suction pump and a range of filter, separator, and other gas treatment systems. The gas will finally either be flared in a flaring system and/or fed to a gas engine directly driven to a generator in order to produce electricity. The power plant system will have a total capacity of 0.3 MW. SWM and GasCon Aps. will in collaboration perform the implementation of the complete technological system (UNFCCC, 2007).

5.7.3. Analysis

The first (telephone) interview undertaken concerning to this case was performed on the 27th of November 2007 with Mr. Frans Teisen. The interview guide pertaining to this interview is appended in Appendix 24[40]. Moreover, an arrangement was made to accompany Mr. Teisen on a visit to the Seelong Sanitary Landfill on the 27th of March 2008[41]. During this visit, an additional interview was carried out with Mr. Teisen. This interview was undertaken without a previously prepared interview guide and can therefore be characterised as of a more unstructured nature. These interviews will respectively be referred to as Teisen (2008a) and Teisen (2008b).The third interview was conducted on March the 18th at the head office of Q2 Engineering Sdn. Bhd. in Kuala Lumpur with Mr. Low King Hserng. The topics of discussion and the interview guide concerning this interview are provided in Appendix 25 and 26. Lastly, an interview was

[39] It furthermore became evident during the field study period that this project had not been implemented owing to disagreement between the parties involved (personal communication with Mr. Frans Teisen from GasCon Aps.).

[40] The topics of discussion, concerning the interview, were previously explained to Mr. Teisen via personal communication (telephone).

[41] In concrete terms, Mr. Teisen was inspecting the technological installations together with Mr. Hserng (from Q2 Engineering Sdn. Bhd.) this day and in this regard had a meeting with representatives of the Indian company Combustion Technologies Pvt. Ltd., which supplied the gas flaring system. I could therefore follow and observe this process during this day.

undertaken with Mr. Koay Chuen Hoe on April the 2nd 2008 at the head office of the company Southern Waste Management Sdn. Bhd. in Kuala Lumpur. In Appendix 27, 28 and 29, the topics of discussion, the interview guide and the coding and interpretation process in relation to this interview are given.

GasCon Aps. was founded in 2000 as a company specialising primarily in the field of energy with undertaking planning, consultancy, supply, and implementation of biogas, landfill gas and combined heat and power production systems to be utilised by district heating networks, industrial plants or individual customers (http://www.gascon.dk/, 2008a). In this context, the employees of the company, which are mainly engineers, have utilised their accumulated comprehensive expertise and experiences from their long–lasting employment in the energy sector (http://dbdh.dk/, 2007). In 2002, GasCon Aps. embarked on a new business strategy, which entailed to concentrate the activities of the company on CDM project involvement in Malaysia, either as consultants or turnkey contractors (http://dbdh.dk/, 2007, Teisen, 2008a). The aspiration to establish business activities in Malaysia was also intended to serve as a pier head for furthering the company's activities in the region[42].

In Malaysia, the management of solid waste has mainly involved final disposal of the waste in landfill sites, which consequently has entailed generation of primarily methane gas emissions (Danida, 2003a, UNFCCC, 2007). Landfill gas extraction projects were therefore by GasCon Aps., and others (see Danida, 2003a, MEWC/PTM/DANIDA, 2004), considered potentially feasible to develop as CDM project activities (Teisen, 2008a). In this regard, GasCon Aps. had a previous extensive record of accomplishment regarding projects involving landfill gas extraction, flaring and utilisation, and could therefore employ the company's core competences in these types of projects (http://www.gascon.dk/, 2008b, Pedersen, 2008). On this background, GasCon Aps. signed in 2003 an agreement with the Malaysian waste management company SWM to jointly develop landfill gas extraction projects in Malaysia (http://dbdh.dk/, 2007). A grant from the Danish Danida Partnership Facility programme subsequently enabled GasCon Aps. and SWM to perform a small–scale demonstration project with the purpose to study the viability of a full scale CDM project at the Seelong Sanitary Landfill[43] (Appendix 29, Teisen 2008b, Danida, 2003b). Based on affirmative results concerning the feasibility of the demonstration project, it was decided to proceed with implementation of the large–scale CDM project[44]. In 2006, GasCon Aps. furthermore established a subsidiary company in Malaysia, Q2 Engineering Sdn. Bhd., with the purpose to provide consultancy services, invest and supply installations and plants in projects that mitigate methane gas emissions (http://www.q2.com.my/, 2008). In continuation of this, GasCon Aps. (through Q2 Engineering Sdn. Bhd.) and SWM in

[42] A contributing motivation factor for this may also concern the general lack of financial support and implementation possibilities in Denmark and the European context (Teisen, 2008a).
[43] The Partnership Facility program contains specific requirements that the parties involved must fulfil in order to receive the grant. This include, inter alia, that the parties are required to engage in a long term and binding relationship that furthermore facilitate technical assistance and transfer of technological know how to the receiving party (Danida, 2003b).
[44] The CDM Executive Board formally registered the project in May 2007 and the project implementation was initiated during 2007 (UNFCCC, 2007, http://dbdh.dk/, 2007).

2007 established the joint venture company SWM_GCENERGYJV (http://dbdh.dk/, 2007). The objective of this company was to enable the companies to jointly venture into landfill gas extraction CDM projects and other type of projects (Appendix 29, Teisen, 2008a, Hserng, 2008). The economic structure of the joint venture was shared between the two shareholders, SWM and GasCon Aps., in a 70% respective 30% ownership of the company[45]. The joint venture agreement entailed that the company would at least proceed with its activities until 2012 owing to the contractual obligation, regarding delivery of CER's, with the Danish embassy (Hserng, 2008).

Southern Waste Management Sdn. Bhd. has since 1995, under a 20–year concession agreement, undertaken solid waste management for the three southern states of peninsular Malaysia Johor, Negeri Sembilan, and Melaka (Appendix 29, http://www.swmsb.com/, 2008). The company serves nearly 5 million people in the three states through its comprehensive and integrated waste management system and employ around 5000 workers. A significant part of the activities of the company entails to design, build, own, and operate landfills (see www.swmsb.com). SWM currently manage and operate 20 landfills and in this regard undertake all activities related to the intermediate processing and disposal of the solid waste. It appears that SWM, prior to the collaboration agreement with GasCon Aps., owing to its extensive access to landfills, wanted to develop gas extraction projects, but lacked the technological expertise to implement such systems (Appendix 29). A key motivation factor for SWM concerning the partnership arrangement was therefore, inter alia, to gain access to, acquire, and internalise the necessary technological knowledge and expertise, through cooperation with GasCon Aps., to carry out such projects (Ibid.).

It seems evident that the collaboration between GasCon Aps. and SWM from the beginning focused on developing CDM projects in Malaysia concerning implementation of landfill gas extraction and utilisation systems (Hserng, 2008, Teisen, 208b). This partnership was formalised into the joint venture company which, as a subcontractor company, was engaged by SWM (the project owner) to undertake organisation and implementation of the complete technological system in project #927 (Hserng, 2008). The concrete installation of the system was therefore arranged as a joint effort between the two companies. In this regard, it appears that the CDM has established channels, through the joint venture company, of technology and knowledge transfer and that the project related internal arrangement therefore is equivalent to the first categorical type of arrangement (cf. chapter 4) (Appendix 29). The overall contractual responsibility of SWM in the project was to undertake the civil work part, including subcontracting specific tasks, and subsequently operate and maintain the implemented technological system. GasCon Aps. was required to prepare the design of the system, supervise the implementation process, and function as a turn key provider which also involved the responsibility to procure the core components (Hserng, 2008, Teisen, 2008b). In this

[45] The Malaysian rules and regulation requires at least 70% ownership by the Malaysian company in installations concerning supply of electricity to the grid (Ellis & Kamel, 2007, Hserng, 2008).

regard, a range of technological hardware components, which could be observed at the project site, was integrated in the complete system[46].

At the outset of implementing the various technological installations in project #927, GasCon Aps. provided SWM with the design plans and the technical drawings of the complete system which, inter alia, contained the critical system performance (measurement) parameters to be taken into consideration (Hserng, 2008, Appendix 29). SWM thereby gained access to technology related codified knowledge regarding the design outlay and configuration of the system. Moreover, it appears that GasCon Aps. and key employees from Q2 Engineering Sdn. Bhd., interacted and collaborated closely with employees from SWM throughout the entire process of implementing the various systems in the project[47] (Appendix 29, Teisen, 2008b).

It is held in the PDD that the there currently does not exist landfill sites in the region that successfully operate gas recovery and utilisation systems, which therefore constitute a key barrier (UNFCCC, 2007). In relation hereto, one of the main obstacles in the implementation process concerned the high level of precipitation in Malaysia in comparison to Europe where the system previously was implemented. Although the basic configuration of the system remained the same, the obstacles induced continued adaptation and incremental redesign of the system, including procurement of new components, in order to increase the efficiency of the system (Hserng, 2008, Appendix 29). During the course of handling and overcoming these challenges, the respective companies' employees communicated on a daily basis, which could also be observed during the visit to the project site. The minutes from discussions in the frequently held meetings, concerning these issues, were subsequently also made available to all SWM employees (Teisen, 2008b). GasCon Aps. primarily performed the redesign and employees of SWM took an active part in providing valuable input and ideas throughout this process. SWM also supplied GasCon Aps. with key information regarding the nature of the waste, local and regional procurement possibilities, organisation of operation of the system within other landfill operation routines, etc.

It seems evident that GasCon Aps. utilised the extensive experiences and accumulated tacit knowledge concerning implementation of landfill gas extraction systems during the process of handling the specific application challenges (Teisen, 2008b). The obstacles were in this regard primarily handled and solved while working on–site (Hserng, 2008). On this basis, the close interaction between the companies facilitated a substantial technological learning process of key employees from SWM and the joint venture company (Appendix 29, Teisen, 2008b). These employees therefore gained insight into the process of performing continues optimisation and improvement of the system, including conducting debugging activities, which significantly contributed to enable an

[46] These components comprised, inter alia, a flaring system from the company Combustion Technologies Pvt. Ltd. (see www.combustiontechnologies.com), a gas analyzer from an English company, a automatic control system (PLC System) from Siemens (see www.siemens.com) (Hserng, 2008, Appendix 29).
[47] This was not least facilitated through that the main office of the joint venture company was located within the office building of SWM. The employees of the joint venture company was furthermore mainly been recruited from SWM (Hserng, 2008).

understanding of the fundamental principles of the technological system (Appendix 29). Furthermore, GasCon Aps. also conducted extensive training of the relevant employees of SWM and the joint venture company in order for these to carry out efficient operation and maintenance of the system (Teisen, 2008b).

GasCon Aps. and SWM both have a strong incentive to optimize the gas extraction efficiency of the system owing to the resulting increase in the generation of CER's and in order to demonstrate that the companies are capable of implementing these projects in Malaysia and in the region in a commercially feasible manner. To streamline the process of developing highly efficient landfill gas extraction projects in the future, through the joint venture company, GasCon Aps. aspire to increase the technological capability of the relevant employees from Q2 Engineering Sdn. Bhd., SWM, and the joint venture company (Teisen, 2008a, Teisen, 2008b). This implies that these employees must acquire further insight into and familiarity with implementation of the systems, including independently handling the associated challenges and performing optimisation activities (Teisen, 2008b). However, GasCon Aps. also considers it necessary to retain employees of SWM and the joint venture company from gaining access to the most essential and vital information, e.g. concerning the process of preparing the design of the system[48] (Teisen, 2008b, Hserng, 2008). This appears attributable to the perceived risk of thereby enabling, especially SWM, to undertake complete implementation of similar systems outside the boundaries of the joint venture company. In this regard, it seems evident that SWM in the medium term (4–5 years), or longer term, independently wish to develop projects similar to project #927 either in Malaysia or in other countries in the region (Appendix 29). Unfortunately, the joint venture contract between GasCon Aps. and SWM has not been attainable, which therefore implies a limited understanding of whether, and under what conditions, this may be a legally authorised option for SWM. It is nevertheless suggested that there on this basis potentially exist an underlying conflict of interest, regarding transfer of technological knowledge, between GasCon Aps. and SWM.

5.7.4. Key findings

This case focused on the activities of the companies GasCon Aps., Q2 Engineering Sdn. Bhd., and SWM, including the relationship and interaction between these companies, through the joint venture company SWM_GCENERGYJV, concerning project #927. It seems evident that the CDM established channels of technology and knowledge transfer between GasCon Aps. and SWM. This was facilitated through the CDM motivated partnership agreement and subsequently throughout the process of cooperation, within the joint venture company, in relation to the implementation of the project. The two companies collaborated closely during all phases of implementing the project, including also during the initial demonstration project. GasCon Aps. has unfolded the accumulated experiences and expertise of the company's employees in order to overcome the specific project related challenges and interacted with SWM in this process. Since SWM was not capable of implementing landfill gas extraction projects, prior to the joint effort with GasCon Aps., it appears that the technological learning of SWM has been quite

[48] This involves, inter alia, information regarding which key parameters to take into account during the design phase and detailed technical calculations that are necessary to conduct this (Hserng, 2008).

substantial. It is considered that the CDM related transfer of knowledge has significantly increased the technologies capabilities of SWM, as a company, to implement and handle this type of technology. It is suggested that the CDM in this regard has facilitated a dynamic assimilation and learning process of the technology, which contribute to enable SWM, either through the joint venture company and/or independently of GasCon Aps., to implement similar projects. Furthermore, it seems evident that the nature of the interaction between the companies allowed SWM employees to gain insight into the process of undertaking incremental reconfiguration and optimisation of the system. In this regard, presupposing a continued close interaction between the companies, it is considered that SWM will become enabled to independently handle the challenges in new projects and to undertake continues improvements. Finally, it needs to be stressed that project #927 also involved the installation of a range of technological hardware components originating from a variety of countries, including India, England, Germany, Malaysia, and other countries in the South East Asian region.

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5.8. The Malaysian Energy Centre and the Malaysian DNA

As mentioned, the field study period in Malaysia involved an opportunity to interview relevant employees from the Malaysian DNA and the Malaysian Energy Centre. These national institutions are involved in the internal process of approving CDM projects in Malaysia. The approval process concern the procedures, documents, and institutions involved before project developers prepare a PDD, which is submitted for validation and registration, as described in chapter 2 (see CDM Energy Secretariat, 2006). The project developers therefore need to achieve formal acceptance by the Malaysian approval system before the validation process can proceed. A central element of the national Malaysian CDM related requirements concern whether the specific project activity confirm to the sustainable development criteria's of Malaysia. In criteria three of this framework, of which the central elements are provided in table 8 below, it appears that technology transfer constitute a key issue, which has been comprehensively described.

Table 8. The technology transfer elements of the sustainable development criteria's.

Criterion 3 - Projects must provide technology transfer benefits and/or improvement in technology
3.3.1. Interpretation:
Technology transfer and/or improvement in technology include both soft and hard elements of technology;
CDM projects should lead to transfer of environmentally sound technologies and know–how;
Improvement in technology implies that the project applies a technology that is more efficient and less carbon intensive;
Technology transfer and/or improvement in technology should support the sustainable development objectives of Malaysia;
Technology transfer and/or improvement in technology should enhance the indigenous capacity of Malaysians to apply, develop, and implement environmentally sound technologies.
3.3.2. Indicators - the relevant indicators should measure the following:
Impact of the project on indigenous capacity to apply, develop, and implement environmentally sound technologies;
Impact on increased use of renewable energy resources and/or increased energy efficiency and/or reduction of green house gas emissions;
Demonstration and replication potential of the technology; and
Impact on domestic energy–related industries and services (increased local content of skills and equipment in energy projects).

Source: CDM Energy Secretariat (2006).

The primary role of the Malaysian DNA, which is located in the Ministry of Natural Resources and Environment in Malaysia (see www.nre.gov.my), is to undertake final approval of the proposed CDM projects in Malaysia. The approval process also involves the national Malaysian committee on the CDM (NCCDM), which assist the DNA on the basis of plenary meetings where relevant stakeholders, pertaining to specific projects, are consulted. Furthermore, the Malaysian Energy Centre (see www.ptm.org.my) is engaged in the approval process by evaluating projects, which involve energy generation. The main interest in relation to the interviews conducted, as can be seen in the interview guides, was to gain insight into the concrete involvement of these institutions in the process of evaluating and approving CDM projects based on the Malaysian sustainable development criteria's. Since the elements in the criteria frame concerning technology transfer had been formulated in detail, it was a key issue to understand how the specific indicators, in concrete terms, had been operationalised and assessed.

The first interview was performed on March 21 2008 in the Ministry of Natural Resources and Environment with the assistant secretaries Mrs. Siti Khadijah Abdul Ghani and Mr. Maximilian T. Conrad. In Appendix 30 and 31, the topics of discussion and the interview guide relating to this interview have been appended. This interview will be referred to as (Ghani & Conrad, 2008). Moreover, an interview was undertaken with research officers Mrs. Noorly Akmar Ramli and Mrs. Wan Nadia Kamarudin from the Malaysian Energy Centre on the 3rd of April 2008 at the head office of this institution. This interview is referred to as (Ramli & Kamarudin, 2008) and the topics of discussion and the interview guide concerning this interview are appended in Appendix 32 and 33.

It seems clear, that technology transfer in the CDM has been a priority for the Malaysian DNA and NCCDM approval system. However, it also appears that the formal indicators related to this issue have not been assessed as detailed as these have been formulated in the sustainable development criteria’s. Technology transfer has in concrete terms been interpreted to require that the original technology design, regarding the main components in a given implemented technological system, should originate from an Annex 1 country company (Ghani & Conrad, 2008). If project developers have been able to demonstrate this sufficiently in their initial project proposals, PDD’s, and in the presentations under the NCCDM plenary meetings, then the projects entail technology transfer (Ramli & Kamarudin, 2008). Malaysian companies involved in CDM projects that are engaged in e.g. technology related license and royalty agreements with Annex 1 country companies, therefore per se involve technology and knowledge transfer. Efforts have not been devoted to assess, in further detail, the concrete technology related processes and interaction between the involved companies during the implementation of the CDM projects. In relation hereto, it is planned that the sustainable development criteria’s of the approval system, regarding technology transfer, will be revised (Ghani & Conrad, 2008, Ramli & Kamarudin, 2008). It seems that this is attributable to various factors, including the problems associated with operationalisation and assessment of technology and knowledge transfer owing to the inherent complexity of the subject (Ghani & Conrad, 2008). Furthermore, it appears to be the general opinion of the above informants that the approval system should not uphold unnecessary barriers for project developers to develop and implement further CDM projects in Malaysia by maintaining technology transfer requirements (Ghani & Conrad, 2008, Ramli & Kamarudin, 2008). This may also reflect an increasing attention towards the existing Malaysian based technology developers, manufactures, etc., which possess well–developed technologies and who are capable of implementing these in CDM projects (Ramli & Kamarudin, 2008). In summation, the Malaysian CDM project approval system has, in practice, implemented and enforced a simpler interpretation and operationalisation of technology transfer in the CDM than was originally formulated in the criteria framework. The involved institutions have not been interested in allocating the resources to enforce a strict procedural administration, involving detailed assessment and verification of this aspect, and instead prioritised not to hinder implementation of further GHG mitigation activities in Malaysia through CDM projects.

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6. Discussion

The purpose of this chapter is to discuss the analytic results presented in chapter 5. First, the chapter will undertake a case–by–case discussion of each of the five cases previously examined. This is followed by a summary discussion, which will concentrate on two overall themes that have been evident in the previous case–by–case discussion.

6.1. Case–by–case discussion

This section will discuss each of the five cases in turn and the discussion within each case is structured around the initially formulated research sub–questions, which are therefore repeated below. As can be seen, the questions reflect the analytical framework adopted in this thesis.

- What companies are involved in the CDM projects, which can be identified as the respective Malaysian transferee and Annex 1 country transferor companies and what kind of relationships are evident between these companies?
- Does the CDM in this regard establish new channels of technology and knowledge transfer between these companies?
- Does the CDM facilitate transfer of technological hardware components from Annex 1 country companies to Malaysia?
- How have the Malaysian based transferee companies developed concerning their core business activities, project involvement, and more, prior and subsequent to their participation in CDM projects?
- In this regard, does the CDM enhance the technological capabilities of the transferee companies, which enable or improve the ability of these companies to handle, implement, develop, etc., the technologies pertinent to the specific CDM projects?

The discussion will therefore address these aspects in relation to the specific cases and include issues related to conceptual understandings of technology transfer as addressed in chapter 4. The intention is to discuss, for every case, what role the CDM plays in relation to technology and knowledge transfer in order to reach an overall evaluation of this question.

6.1.1. Case one discussion

The activities of the Belgium company Vyncke Energitechniek N.V. is in the Malaysian context carried out through its subsidiary company Vyncke East Asia Sdn. Bhd. although it is more precise to consider these affiliated companies as one corporation undertaking activities in Malaysia. The company is well established in Malaysia and it seems evident that its activities in the Malaysian context cannot be considered as a general consequence of the CDM. The CDM has in this regard only established channels of technology and knowledge to the technology end user companies where focus primarily has been on the company Hartalega Sdn. Bhd. This type of project related internal arrangement has only been identified in this case.

The core technological components in the complete boiler system installations concerning the projects addressed in this case, including the combustion system, have been transferred from the production sites owned by Vyncke in Europe and China. Therefore, if technology is viewed as only encompassing the hardware dimension, the core components have, in concrete terms, been transferred from Annex 1 countries in Europe, although Vyncke's production units are increasingly shifting to localisations in China (a Non Annex 1 country). Applying this perspective, which appears to be in accordance with the evaluation procedure and approach of the Malaysian CDM approval system, also taking into consideration its focus on the origin of the technology, therefore imply technology transfer.

The standard business strategy for Vyncke is to supply tailor made boiler system solutions in Malaysia and in other countries. The challenges associated with utilising EFB's can therefore be seen as a continuation of the previous activities of the company in Malaysia. In reference to chapter 2, this relates to the novelty aspect of the technology and it seems reasonable to assume that the obstacles in the projects, as held in the PDD's, have been substantial and that the technology in this regard has undergone changes and modifications. However, it appears to be inconclusive and questionable whether these challenges have been overcome because of technology and knowledge transfer. One interpretation may be that technology transfer is occurring since Vyncke is a company based in an Annex 1 country, which has effectively solved the project related technological challenges owing to their expertise and accumulated knowledge within this field. This interpretation seems to prevail in the PDD's and validation reports pertaining to this case, which also stress the lacking level of skills of the operators to carry out operation and maintenance as a central element of the transfer process. As mentioned in chapter 2, these arguments may constitute a basis for project proponents to demonstrate additionally, which may have implications for transfer of technology and knowledge.

It seems clear, that the accumulation of technological capabilities has been limited to enable the technology end user company's operators, through training activities, to operate and maintain the implemented boiler system. In this regard, it is a key priority for Vyncke that the end users, as well as the subcontracting companies involved in the projects, and other companies in general, are prevented from gaining insights into the design configuration, performance parameters, and other valuable and fundamental aspects of the technology. In reference to chapter 4.2.2., the transfer and implementation of technological hardware components have in this regard not facilitated a possibility for the transferee companies to gain substantial insights into the boiler systems. It therefore seems to be evident that the CDM project involvement of the transferee companies and Vyncke does not entail a type (or nature) of cooperation and interaction that could facilitate a long–term process of technological learning involving accumulation of higher levels of technological capabilities (as described in chapter 4, section 4.2.2.2.). In relation hereto, it needs to be stressed that the technology end user companies, in general, may not necessarily have an interest in gaining further insights into the technological system in addition to achieving operational capabilities. This especially concerns the rubber glove manufacturing company Hartalega Sdn. Bhd., which does not specialise or undertake activities related to manufacture, design, development, consultant services, etc., of components, subsystems, or complete boiler systems.

Based on the key factors taken into consideration in this thesis, as presented in the analytical framework, the above seem to suggest that the CDM, as an overall evaluation regarding this case, has played a limited role in relation to the transfer of technology and knowledge. Nevertheless, other interpretations as the abovementioned are possible, which fundamentally depend on the understanding and conceptualisation of technology transfer. In this regard, it appears that the CDM has played a contributing role in relation to increase the volume, or further the number of applications, of the Vyncke boiler system in Malaysia. Vyncke does not consider their CDM project involvement as a priority per se, but regard the CER revenue stream, which investors obtain through CDM projects, as a central aspect, among other factors, that increase the financial viability of implementing project activities involving boiler systems utilising EFB's. The CER's thereby contribute to shorten the payback time of investments in the projects, which essentially enables Vyncke, as a technology supplier, to increase its application volume. Adopting another perspective therefore, the CDM may be seen as an important financial mechanism, which attracts and thereby reduces barriers related to investments into GHG mitigation projects possibly facilitating, although not necessarily, technology and knowledge transfer.

An interesting finding from this case concerns the attention that Vyncke paid to the local Malaysian companies, including subcontractors, boiler system manufacturers, and others, to hinder diffusion of technology related knowledge to these. This ultimately concerns a demarcation issue in relation to this thesis since the implemented boiler systems may render it possible, for other than the directly involved companies to visit the project sites and/or in other ways, and in a longer time perspective, gain access to learn about these systems. Although this aspect is outside the scope of this thesis, as explained in chapter 4, these companies may be relevant to take into consideration in further assessments of technology and knowledge transfer.

6.1.2. Case two discussion

The Malaysian based company ENCO Systems Sdn. Bhd. was identified as the transferee company together with the technology user companies pertinent to the specific projects addressed in this case. ENCO has since 1993 manufactured and implemented Danstoker A/S boiler systems initially under a license and subsequently under a royalty payment agreement. Furthermore, the cooperation agreement with B & W Volund enabled ENCO to manufacture and implement the boiler system, originally designed by B & W Volund, also under a royalty contract. This arrangement was initiated in 1997 and it seems evident that ENCO during the following years, although before the company's involvement in CDM projects, became capable of implementing the boiler system independently of B & W Volund (and Danstoker A/S). The activities of ENCO in Malaysia, concerning implementation of boiler systems utilising biomass residues from the Malaysian palm oil industry can therefore not be understood as a direct consequence of the CDM. The CDM in this regard only established channels of technology and knowledge transfer to the technology end user companies.

It seems that ENCO has developed as a company from its commencement in 1975 by undertaking gradually more demanding activities in relation to boiler system technologies. Moreover, the partnership agreement and the appertaining process of cooperation and interaction with B & W Volund contributed to stimulate this progression. This finding seems to be in accordance with the technology conceptualisation and proposition put forward in chapter 4 (section 4.2.2.2.), where technology and knowledge transfer is understood as an external and supplementary factor that, through a process of interaction and learning, can contribute to enhance the accumulation of technological capabilities of the receiver company. However, it seems that the capabilities to implement and undertake incremental modification and adjustments of the boiler systems, in specific application contexts, have been accumulated before the CDM project involvement. Since ENCO furthermore is capable of undertaking redesign and development of specific subsystems, the level of technological capability may be referred to as more advanced and innovative.

Seen in a historic context, the above suggests that the CDM allow ENCO to increase the volume of boiler system applications in Malaysia in a similar manner as the case above. In relation hereto, the technological barriers associated with the projects have been handled and overcome independently by ENCO and it therefore seems questionable whether this is a consequence of technology and knowledge transfer. On the other hand, if a narrower understanding is adopted, in which technology is perceived as embodied in capital goods, the projects specifically addressed in this case do facilitate transfer of core technological hardware components from companies in Annex 1 countries to Malaysia. Although the core components of the boilers' combustion systems are manufactured by ENCO in Malaysia, various integrated subsystems originate from different Annex 1 country companies. In continuation hereof, the Malaysian CDM approval system understands the projects that ENCO has been involved in as implicitly entailing technology and knowledge transfer since B & W Volund (as an Annex 1 country based company) originally developed the boiler design, although this was not motivated by the possibility to implement CDM projects. This interpretation or argument also appears to be evident in the PDD’s and validation reports pertaining to this case. In this regard, it seems fair to suggest that the authors of the PDD’s in general may have an interest in formulating this argument in a manner that corresponds to the interpretation applied by the Malaysian approval system.

The accumulation of technological capabilities regarding this case has been limited to enable the relevant operators to carry out operation and maintenance of the boiler systems. The transfer and implementation of the technological hardware components have thereby not facilitated a possibility for the end user companies (or ENCO) to gain substantial insights into the boiler systems. Based on the key factors taken into consideration in this thesis, the above seems to suggest that the CDM, as an overall evaluation regarding this case, has played a limited role in relation to transfer of technology and knowledge. However, ENCO considers the CDM related CER revenue as an important element that renders the projects more financially viable for the company to venture into both as investor and/or as technology provider. This finding is identical to the case discussed above, in which the CDM constitute a central role as a financial mechanism, which contributes to increase the volume of the company’s boiler systems applications in Malaysia. Again, the increased financial feasibility and subsequent investments into the projects addressed in this case, does not necessarily carry with it the transfer of technology and knowledge as this has been conceptualised in this thesis.

A further finding in this case concern that ENCO considers it important to practise a strict visiting policy at their project sites, in order to prevent various companies from gaining insight into the implemented systems. This aspect concerns the same discussion as in the case above where the demarcation initially adopted in this thesis may focus too narrowly on the companies that in concrete terms have been involved in the CDM projects.

6.1.3. Case three discussion

In this case, the primary interest concerned the Canadian company Heuristic Engineering Inc. and the Malaysian based transferee company MHES Asia Sdn. Bhd. in relation to their involvement in CDM project #1091. Heuristic Engineering Inc. ventured in 2004 together with its Canadian technology manufacture company Northern Steel Ltd. and MHES Asia Sdn. Bhd. into the Malaysian based joint venture company Meridian Utilities Sdn. Bhd. Evidently, the joint venture company was not commenced in order to develop or participate in CDM projects and it therefore appears that the CDM in this regard did not establish channels of technology and knowledge transfer. However, it has not been possible to assess whether the CDM was an underlying strategic motivation factor for MHES Asia Sdn. Bhd. to enter into the joint venture agreement. This is a consequence of the unfortunate lack of interest or willingness of the relevant employees from this company to participate in an interview concerning the subject of this thesis. It is considered that this circumstance constitutes a significant shortcoming regarding both company and project specific information that, inter alia, renders it difficult to achieve an understanding of the detailed processes associated with the implementation of the project activity.

The technology related ownership relations between the companies in the joint venture, as laid out in the contractual agreement, appear to be of a highly shared and integrative nature. This aspect may be in accordance with earlier findings, as referred to in chapter 4 (section 4.2.2.2.), suggesting that a more integrated and binding agreement between the involved parties can induce a larger willingness to exchange valuable technology related knowledge. In relation hereto, Heuristic Engineering Inc. provided MHES Asia Sdn. Bhd. with the general arrangement drawings of the Envirocycler technology at the outset of the joint venture partnership. Based on this information, it seems evident that MHES Asia Sdn. Bhd. was capable of undertaking implementation of the Envirocycler technology in the CDM project activity. The project was registered in 2007, which suggests that MHES Asia Sdn. Bhd. may have been familiar, through previous experiences, either with implementation of this system and/or with similar systems, since the company had the capabilities to successfully install and operate the Envirocycler technology. This finding may suggest that technology and knowledge transfer processes also depend on, or are influenced by, the previous experiences and competences of the receiver company. Previously accumulated technological capabilities may in this regard increase the ability of the company to acquire and adapt new technological knowledge.

It appears that the Envirocycler combustion technology, which constitutes a core technological hardware component in the CDM project, has not been manufactured by Northern Steel Ltd., as initially agreed upon in the joint venture contract, and subsequently transferred to Malaysia. Instead, MHES Asia Sdn. Bhd. has subcontracted manufacture of the constituting subcomponents primarily from Malaysian subcontractor companies. The other main component in the project, the steam turbine, was in concrete terms transferred from the production site of NG Metalúrgica Ltda. in Brazil and implemented through the Malaysian company Jessen Technology Sdn. Bhd. This process therefore implies transfer of technological hardware to Malaysia although from a Non Annex country based company. In the PDD pertaining to this case, emphasis is put on the Canadian based (Annex 1 country) company to claim technology transfer, although this aspect has not been clarified in further detail in the neither the PDD nor the validation report. Since the technology was originally developed in an Annex 1 country and subsequently implemented in Malaysia this conform to the technology transfer related criteria's and interpretation of the Malaysian CDM approval system. However, based on the factors taken into consideration in this thesis, it is suggested that the CDM, as an overall evaluation regarding this case, has played a limited role in relation to transfer of technology and knowledge. This relates both to the initiation of the joint venture and the transfer of technical drawings prior (and not in relation) to the CDM project activity, and the evident absence of interaction between the companies during the implementation of the project.

6.1.4. Case four discussion

Case four focused on the Malaysian company Vickers Hoskins Sdn. Bhd. and the UK based technology developer company Doosan Babcock Energy Ltd. in relation to project #558. Vickers Hoskins Sdn. Bhd., which is a well established company in Malaysia, has since 1980 under a license agreement manufactured a boiler system, which was initially designed by Doosan Babcock Energy Ltd. to utilise various biomass input materials in different application contexts in Malaysia. Furthermore, it appears that Vickers Hoskins Sdn. Bhd. independently, since the initiation of the license agreement, has undertaken implementation of this system, including performing the necessary modifications. As the boiler system has been manufactured and implemented under the license agreement in the specific project activity, the CDM has only established channels of technology and knowledge transfer to the technology end user company. Unfortunately, it was not possible to carry out an interview with a relevant employee from Doosan Babcock Energy Ltd., which constitutes a significant limitation of information regarding this case.

In relation to the concrete CDM project activity in this case, it seems that the associated technological challenges has involved close interaction and cooperation between Vickers Hoskins Sdn. Bhd. and Doosan Babcock Energy Ltd. in order to overcome these barriers. This type of procedure has been evident since the initiation of the license agreement between the companies although it has not been possible to access the contractual arrangement regarding this aspect. In projects that involve a more substantial reconfiguration of the basic boiler design outlay, the technical office of Doosan Babcock Energy Ltd. assists in undertaking detailed calculations and control of the redesigned boiler system. Through this process, which seems to have occurred in the specific project activity, Vickers Hoskins Sdn. Bhd. became enabled independently to carry out implementation of the redesigned boiler system in future projects. Therefore, in a narrow sense, the interaction with the license holder company facilitated learning and accumulation of technological capabilities. Yet, it does not appear that Vickers Hoskins Sdn. Bhd. gained insights into the process of performing redesign and fundamental alterations of the outlay of the boiler system, which enable the company (subsequently and independently) to perform this procedure. These activities, undertaken by Doosan Babcock Energy Ltd. employees, may be characterised as more research and development based and innovative in nature. The CDM project involvement may in this regard be seen as one element of a long–term process of collaboration and interaction that facilitate learning whereby Vickers Hoskins Sdn. Bhd. over time can accumulate higher levels of technological capabilities. However, it appears that Vickers Hoskins Sdn. Bhd. subsequent to its CDM project involvement essentially continues its previous activities. This discussion reflect that it can be difficult to separate the CDM related learning impacts from the normal interaction between companies in cases where cooperation is a long–term and ongoing process. The accumulation of technological capabilities concerning the end user company was limited to enable the operators perform operation and maintenance of the complete system. It therefore appears that the transfer process did not facilitate a possibility for this company to gain substantial insights into the system.

In the project, the main technological hardware components in the complete implemented installation include the boiler system (manufactured and implemented by Vickers Hoskins Sdn. Bhd.) and the steam turbine, which most likely originate from the Brazilian company NG Metalúrgica Ltda. Therefore, in concrete terms, it seems that the main hardware components have not been transferred from Annex 1 countries. However, interpreted by the Malaysian CDM approval system this project activity inevitably facilitates technology and knowledge transfer since the license holder company located in an Annex 1 country company originally developed the boiler technology. Nonetheless, based on the factors taken into consideration in this thesis it is suggested that the CDM, as an overall evaluation concerning this case, plays a limited role in relation to transfer of technology and knowledge from Annex 1 countries to Malaysia.

It needs to be mentioned that Vickers Hoskins Sdn. Bhd. also considers the CER revenue associated with undertaking the activities as CDM projects as an important element that increase the financial viability of implementing the boiler system of the company in Malaysia. This finding concurs with cases one and two, as discussed above, in which the CDM, as a financial mechanism, contribute to increase the volume or furthers the boiler system applications in Malaysia.

6.1.5. Case five discussion

Case five concentrated on the activities of the companies GasCon Aps., Q2 Engineering Sdn. Bhd., and Southern Waste Management Sdn. Bhd. (SWM), regarding the relationship and interaction between these companies, through their joint venture company, concerning project #927. It seems clear that SWM, as the identified transferee company, was not involved in development and implementation of gas recovery system projects prior to its involvement with GasCon Aps. in project #927. Furthermore, the collaboration between GasCon Aps. and SWM has from the beginning, both in the initial cooperation agreement, and subsequently through their joint venture company focused on developing CDM projects in Malaysia concerning implementation of landfill gas extraction and utilisation systems. In this regard, the activities of GasCon Aps. in Malaysia appears to be a direct consequence of, and directly motivated by, the possibility to undertake CDM projects. This circumstance, where an Annex 1 country company has established and based its activities in Malaysia on the CDM seems only to be evident in this case. It seems likely, that an incentive for GasCon Aps. to venture overseas also may have concerned the domestic situation in Denmark, inter alia relating to lack of financial support for the company’s activities.

It appears that the interaction process between GasCon Aps. and SWM throughout implementation of the project activity can be characterised as described in chapter 4 (section 4.2.2.2.). Technology and knowledge transfer is here understood as a process whereby the receiving organisation can tap into the knowledge base of the external organisation. In this regard, the transfer process constitutes an external factor that can increase the technological capabilities of the transferee company in relation to the technology in question. This appears to have been evident in relation to this case. SWM employees have gained extensive insights into the methods and procedures that have been applied to install, optimise, modify, and thereby effectively implement the complete system. Furthermore, the binding ownership and shared nature of the joint venture company also seem to have contributed to enhance the willingness to exchange valuable codified and tacit knowledge regarding the technological system.

GasCon Aps. has facilitated the possibility for employees of SWM and the joint venture company to gain substantial insights into the process of implementing the system through its supervisory role in the project. It therefore appears that these employees have undergone a substantial learning process, which has contributed to enable SWM independently and/or through the joint venture to carry out implementation of the system. The accumulation of technological capabilities has thereby not been limited to enable the relevant operators to perform operation and maintenance of the system. This type of technological learning seems only to be apparent in this case. A contributing factor in this regard, may concern the criteria's contained in the grants given by the Danish Danida programme, which require the parties to engage in a long term and binding relationship that e.g. facilitate technical assistance and transfer of know how. In reference to chapter 4 (section 4.2.2.2.), the establishment of a joint venture company may have been motivated by a wish for GasCon Aps. to retain strategic control of the core assets of the technology. However, an unresolved aspect relate to the development of similar projects in the future since it is unclear whether the contractual obligations allow SWM to carry out projects independently. In relation hereto, it seems plausible that both GasCon Aps. and SWM may wish to venture independently and as project owners (with own rights to the generated CER's) into specific CDM projects in future projects. On the other hand, there also seem to be a common interest in enabling SWM to become increasingly responsible for undertaking the main part of the implementation process within the joint venture company.

The main technological hardware components that, in concrete terms, have been transferred from Annex 1 countries in relation to this case include a gas analyser system and an automatic control system, beside a flaring system from India (a Non Annex 1 country). Interpreted by the Malaysian CDM approval system this project facilitates technology and knowledge transfer owing to the focus on GasCon Aps. as an Annex 1 country based company. As mentioned, it seems that the employees of SWM have gained extensive insight into the functionality, composition, outlay, arrangement, purpose, etc., of the hardware implemented in the project activity. This aspect seem to have been substantiated thoroughly in the PDD as a central element of the technology transfer process, which also take into consideration that only one landfill in the region currently operate gas recovery and utilisation systems successfully. The technological barriers pertaining to the project can therefore be considered to have been overcome through technology and knowledge transfer in the CDM. Therefore, based on the factors taken into consideration in this thesis, it appears that the CDM, as an overall evaluation, has played a pivotal role in relation to transfer of technology and knowledge concerning this case.

In table 9 below, the central elements of the previous discussion of the five cases is provided, which presents each case in relation to an overall evaluation of the research sub–questions.

Table 9. Case–by–case discussion and overall evaluation of research sub–questions.

Sub-questions / Case No.	Project related internal arrangement	Establishment of channels of transfer	Transfer of technological hardware from an Annex 1 country	Implications of CDM involvement	Accumulation of firm–level technological capabilities
1	- Vyncke operates as one company in Malaysia through its fully owned subsidiary company	- The subsidiary company existed prior to the company's CDM involvement - Establishes channels to technology end users	- There is transfer of technological hardware, but the CDM does not allow the technology end users to gain substantial insights into this hardware	- Vyncke essentially continues its previous activities in Malaysia by developing tailor made boiler system solutions	- Enablement of the relevant technology end use operators to carry out operation and maintenance of the technology
2	- ENCO produce boiler technologies under royalty agreements with Danstoker A/S and B & W Volund	- ENCO was engaged in the royalty agreements before the company's CDM involvement - Establishes channels to technology end users	- There is transfer of technological hardware, but the CDM does not allow the technology end users to gain substantial insights into this hardware	- ENCO continues its previous activities, which involves to manufacture and implement boiler technologies	- Enablement of the relevant technology end use operators to carry out operation and maintenance of the technology
3	- MHES formally implement the Envirocycler technology under a joint venture agreement	- The joint venture company existed prior to the company's involvement in CDM projects	- There is not transfer of technological hardware from an Annex 1 country company	- MHES continues its previous activities in Malaysia concerning implementation and management of small power plants	- Enablement of the relevant technology end use operators to carry out operation and maintenance of the technology
4	- Vickers Hoskins manufacture and implement boiler technologies under a license agreement with Doosan Babcock	- The license agreement existed prior to the company's involvement in CDM projects - Establishes channels to technology end users	- There is not transfer of technological hardware from an Annex 1 country company	- Vickers Hoskins continues its previous activities, although the company can subsequently implement the redesigned boiler	- Enablement of the relevant technology end use operators to carry out operation and maintenance of the technology
5	- SWM and GasCon Aps. jointly implement the landfill gas recovery technology under a joint venture partnership	- The initiation of the partnership was directly motivated by the possibility to venture into CDM projects involving lndfill gas recovery	- There is transfer of technological hardware from an Annex 1 country company and the CDM allow SWM to gain comprehensive insights into this hardware	- SWM is now, through the CDM, engaged in implementation of landfill gas extraction and utilisation projects in Malaysia	- Enablement of SWM, as a company, to carry out implementation of the technological system pertaining to CDM project #927

6.2. Summary discussion

The following section will concentrate on two overall themes that have emerged, and which are relevant, in relation to the previous case–by–case discussion. The first theme focuses on the conceptualisation of technology transfer and in this regard considers general discussions concerning provisions of the CDM. The second theme relates to a more specific discussion regarding local diffusion of existing technologies.

6.2.1. Conceptualisation of technology transfer

As mentioned earlier, the Kyoto protocol contained, both in the political procees preceding its adoption and ultimately in the final text, in relation to the CDM, a central element regarding technology and knowlegde transfer to developing country parties. Technology transfer was moreover explicitly reiterated and further emphasised in the Marrakech accords as a central aim of the CDM. However, mandatory requirements have not been formulated and implemented, which currently makes technology transfer in the CDM a relatively uncontrolled and unmonitored subject. This circumstance contributes to complicate the process of evaluating whether and how the CDM facilitate technology and knowledge transfer. This also relates to a general discussion concerning how evaluation frameworks with specific technology transfer related indicators can be formulated, operationalised, and assessed in concrete terms in CDM projects.

As demonstrated in the previous case discussions, a specific perspective has been adopted by the Malaysian CDM approval system, which concentrates on and emphasises the origin of the technology design. Regarding the projects that involve boiler systems, this approach seems to involve a simple and unproblematic assessment procedure since all the involved Malaysian based companies, prior to their CDM project involvement, have been affiliated with Annex 1 country companies. As was evident in chapter 5 (section 5.8.) however, the condition that an Annex 1 country based company is required to be the technology provider may not constitute an appropriate arrangement in the Malaysian context. This requirement could effectively sustain barriers that hinder implementation of specific CDM project activities that is considered attractive. In this regard, project developers may actually be obstructed from implementing GHG mitigation activities because of technology transfer obligations. As mentioned, these demands will therefore most likely be removed, inter alia owing to the existence of well–developed and available technologies in Malaysia and in the region, which can be implemented in certain sectors and industries in CDM projects. This issue relates to a general discussion concerning implementation of technology transfer related obligations in the CDM, especially in political discussions regarding the second commitment period (or a post 2012 framework) of the Kyoto protocol. It is considered that the problems associated herewith, as mentioned above, are not only apparent in the Malaysian context and the situation may be similar in other Non Annex 1 countries with access to local or regional available technologies. This may be reflected in that different Non Annex 1 countries have not formulated provisions regarding technology transfer in their sustainable development criteria's.

An essential and underlying discussion concerns how technology, the object of the transfer process, is understood and conceptualised regarding both provisions and assessments of technology transfer. As mentioned in chapter 4, the perspective often adopted in relation to technology transfer in a climate change context, concentrates on the hardware dimension of technology. The transfer of technological components, subsystems, and/or complete systems, which ultimately cause a net reduction in GHG emissions, is therefore one way of conceptualising the process and objective of technology transfer in the CDM. If adopted here, it appears that the CDM, based on the previous discussion, in three cases (pertaining to specific projects) has facilitated transfer of the main technological hardware components from Annex 1 countries to Malaysia. In this sense, the CDM may be said to facilitate transfer of technology through these projects, presupposing that the generated CER's, at issuance stage, represent real and additional emission reductions. This approach may be relevant concerning discussions of possible future provisions and modalities of the CDM regarding technology transfer both in relation to different DNA approval systems and in relation to the regulatory system under the CDM executive board. It is unclear however, whether requirements for hardware transfer from Annex 1 countries, as described here, will be a general acceptable condition for the different parties to the Kyoto protocol.

The perspective adopted in this thesis attempts to include technological hardware as one element or dimension of an integrated technology understanding. Moreover, technological hardware has primarily been taken into consideration insofar as the transfer process facilitates the possibility for Malaysian companies to gain comprehensive insights into the technology. In this regard, technology transfer is considered a learning process over time, which can stimulate and increase the technological capabilities of the relevant receiver companies concerning the technology in question. As mentioned previously, technology transfer often concerns the transfer of hardware and accumulation of operational capabilities in the technology end user companies through short–term training activities. This appears also to be evident in all the projects taken into consideration in this thesis. Yet, the Seelong Sanitary Landfill project stands out as SWM has been, and still is, in the process of accumulating technological capabilities in addition to qualifying the relevant operators to carry out operation and maintenance of the technology. This situation differs from the other cases in which existing Malaysian based companies have been capable of undertaking implementation of the different systems, including handling the challenges, or overcoming the barriers, associated herewith. It can be argued however, in relation to Vickers Hoskins Sdn. Bhd., that this company may not have been independently capable of performing the necessary system design alterations.

Applying the understanding of technology transfer processes adopted in this thesis may have various implications in relation to both provisions and assessments of the CDM. First, it involves a comprehensive evaluation undertaking regardless of whether this is conducted by a designated national authority in a Non Annex 1 country, a body under the CDM executive board, e.g. the appurtenant panels, the DOE's, or others. A further complication of the project cycle procedure, involving also additional allocation of time and financial resources, may in this regard not be considered desirable for the CDM. Furthermore, if accumulation of technological capabilities is to be an objective or element of technology transfer in the CDM, this may require closer and more binding interaction and technology related ownership between the companies involved. This may discourage technology manufacturer and/or developer companies to participate in project activities. It may also constitute an unfeasible challenge to agree upon the design of quantitative and/or qualitative indicators and measures to evaluate technology and knowledge transfer. In this regard, a question concerns whether it should be the responsibility of the respective Non Annex 1 countries to formulate such indicators or whether overall and uniform provisions should be enforced by the regulatory system of the CDM. Other problems may be associated with this perspective and the issue of technology transfer in the CDM fundamentally needs to be compared and balanced with other relevant objectives, intentions, and purposes of the CDM.

6.2.2. Local diffusion of existing technologies

A central discussion regarding the projects addressed in this thesis concerns the apparent continuance of the Malaysian based technology manufacturer companies' previous activities through their CDM project involvement. Although not a technology manufacturing company this also seems evident in relation to the activities of MHES Asia Sdn. Bhd. Concerning the companies Vyncke East Asia Sdn. Bhd., ENCO Systems Sdn. Bhd., and Vickers Hoskins Sdn. Bhd., the CDM has in Malaysia essentially allowed these to increase the number of boiler system applications. Although the different boiler systems have been modified to meet the requirements in specific projects, this may be referred to as a process of local diffusion of existing technologies. In the Malaysian context and specifically regarding boiler technologies, the CDM therefore provides a financial incentive, through the generation of CER's, for project developers to initiate projects that involve these systems. As discussed above, this process does not necessarily entail technology and knowledge transfer, although this ultimately depends on how this is conceptualised. The CDM does however seem to function as a financial mechanism that contributes to increase the volume of boiler applications and thereby GHG mitigation activities in Malaysia. This may suggest that discussions addressing technology transfer in the CDM, especially in political deliberations concerning a post 2012 framework, also need to consider the appropriateness of local technology diffusion. In continuation hereof, technology transfer between Non Annex 1 countries through the CDM may also constitute a key issue in this regard. Technology transfer from Annex 1 countries to Non Annex 1 countries may therefore, in certain countries and in relation to specific technologies, not be relevant. In relation hereto, it may be fruitful to undertake thorough analysis of specific technologies related to various sectors and industries relevant for different countries.

As could be seen from the previous case–by–case discussion, a central demarcation issue concerns the companies taken into consideration in this thesis. At the outset the preparation of this thesis, it was decided that the relevant companies comprise those that in concrete and direct terms have been involved in the specific CDM projects. Other companies, especially sub contractors and local technology manufacture companies, may however be indirectly influenced by, and may have an interest in learning about the technological systems implemented. Therefore, the findings of this thesis do not take into consideration the wider national learning system regarding these technologies. In this regard, an interesting element of further studies could be to study, for example, the CDM related influence on Malaysian boiler manufacturing companies.

7. Conclusion

The purpose of the thesis is to contribute to a greater understanding of technology and knowledge transfer in the CDM. The previous conducted studies on this subject have concentrated on the PDD's of CDM projects and the claims regarding technology transfer contained in these. In this thesis, an in–depth case study of concrete implemented CDM projects is undertaken in order to understand the processes, at the micro–level, of technology and knowledge transfer and the experiences of the relevant actors involved. At the outset, the main research question of this thesis was put forward, which is repeated below:

What role do CDM projects play in relation to the transfer of greenhouse gas mitigation technologies from Annex 1 countries to Malaysia?

An analytical framework was developed to answer this question, which accounts for the conceptualisation of technology transfer adopted in this thesis. The primary factors constituting this framework were reflected in the research sub–questions also stated initially. The following will in turn address these sub–questions in order to reach a conclusion concerning the main research question.

- What companies are involved in the CDM projects, which can be identified as the respective Malaysian transferee and Annex 1 country transferor companies and what kind of relationships are evident between these companies?

In total, thirteen registered CDM projects, implemented in Malaysia, have been taken into consideration in this thesis. It has been shown that various companies, involved in specific projects, could be identified as the relevant transferee and transferor companies and that different underlying CDM project related internal arrangements between these were evident. These arrangements include various formal structures between the involved companies, including subsidiaries, license and royalty agreements, joint ventures, and other partnership arrangements. Moreover, it was possible to categorise the constellation of these companies into five cases, where each case denotes the companies that directly and in concrete terms have been involved in implementation of the technological systems in specific CDM projects.

- Does the CDM in this regard establish new channels of technology and knowledge transfer between these companies?

The CDM has established channels of technology and knowledge transfer to the technology end user companies. But more interestingly for this thesis, the CDM has only established channels to one transferee company which could potentially become enabled to handle implemention of the technological system as a consequence of the CDM. This concern the Seelong Sanitary Landfill CDM project, which represent one out of the thirteen examined projects. The CDM has in this regard been the direct and primary motivator for an Annex 1 country company to establish its activities and implement the specific gas recovery and utilisation technology in Malaysia. Regarding the remaining identified transferee companies in Malaysia that manufature and/or implement technologies to the CDM projects addressed in this thesis, their relationsship with Annex 1 country companies existed prior to their CDM project involvement.

- Does the CDM facilitate transfer of technological hardware components from Annex 1 country companies to Malaysia?

In three cases, representing specific CDM project activities, it was evident that the main hardware components in concrete terms have been transferred from Annex 1 countries to Malaysia. However, technological hardware is in this thesis primarily considered interesting insofar as the transfer process facilitates a possibility for Malaysian companies to gain substantial insights into the different aspects of the hardware in question. This has only been observed in the Seelong Sanitary Landfill CDM project, which is one of the three cases.

- How have the Malaysian based transferee companies developed concerning their core business activities, project involvement, and more, prior and subsequent to their participation in CDM projects?

It has been shown that the transferee companies in Malaysia that manufature and/or implement biomass boiler technologies pertaining to the specific CDM projects are well–established in Malaysia. Their involvement in the specific CDM projects can therefore essentially be seen as a continuation of the companies' previous activities. In this regard, it is suggested that the CDM has played a central role in relation to increase the number of boiler system applications in Malaysia. This is attributable to the financial incentive associated with the CDM related CER revenue that render project activities more financially viable for project developers to initiate. However, the Malaysian company Southern Waste Management Sdn. Bhd. (SWM) is becoming capable of undertaking, or participating in performing, implementation of the technological system pertinent to the Seelong Sanitary Landfill CDM project.

- In this regard, does the CDM enhance the technological capabilities of the transferee companies, which enable or improve the ability of these companies to handle, implement, develop, etc., the technologies pertinent to the specific CDM projects?

Technology and knowledge transfer has in this thesis been understood as a learning process over time that can contribute to enhance the technological capabilities of the transferee companies. The question has therefore been whether the CDM project involvement enables or improves the capabilities of these companies to undertake implementation, and handle associated challenges independetly, or generate changes in the technology in question. It has been found that the CDM enable the technology end user companies to perform basic operation and maintenance of the implemented technologies. This is considered to be at the lowest level of accumulation of technological capabilities. However, is has been shown that SWM, through technology and knowledge transfer from an Annex 1 country company under the CDM, has been and still is in the process of accumulating technological capabilities to implement the gas recovery technology pertinent to the Seelong Sanitary Landfill CDM project.

Based on the above, it can be concluded that the CDM only plays a role in relation to the transfer of technology and knowledge from Annex 1 countries to Malaysia in one registered and implemented CDM project in Malaysia, which concerns the Seelong Sanitary Landfill CDM project. This project stands out, as the CDM is the primary reason for an Annex 1 country company's engagement in a long–term, close, and binding partnership with a Malaysian company, which facilitates substantial transfer of technology and knowledge. Through this project, the transferee company gain access to comprehensive insight into fundamental aspects and principles of the technological system and thereby accumulates technological capabilities necessary to handle implementation of the technology. The process that takes place in the remaining examined projects can essentially be characterised as local diffusion of existing technologies. This process does not entail technology and knowledge transfer as this has been conceptualised in this thesis. The Seelong Sanitary Landfill CDM project also differs from the remaining projects as it concerns the management of landfill gas extraction whereas the other projects concern biomass boiler technologies. As opposed to boiler technologies, there seems to be limited capability at the company level to handle implementation of landfill gas recovery and utilisation systems in Malaysia. This finding may therefore suggest that technology transfer cannot be expected in Non Annex 1 countries in which the technology in question is well–developed and the capability to implement and/or possibly develop the system is present.

The focus in the thesis on the micro–level processes of technology transfer has contributed to provide insight into the strategic behaviour of the concrete companies involved. First, it is evident that it is quite complex to understand and assess the dynamics of technology transfer at this level. In addition, it seems that companies do not engage in 'technology transfer' activities as such, but instead in technology procurement, contracts, license, royalty, and fee agreements, joint ventures, and other company related links. It is considered important to concentrate on these commercial and technology related ownership relationships between the companies to understand the dynamics at the micro–level. The extent to which the links between the companies in question are close and binding in nature seem to encourage the parties to exchange valuable technological knowledge. The character of the relationship thereby seems to play a role for the substance and quality of the technology and knowledge transfer process. It is furthermore suggested that the transferor companies may not have incentives to transfer substantial technological knowledge necessary to perform implementation and/or development of the technology in question. This may therefore constitute a potentially underlying limitation to the development of firm–level technological capabilities through technology transfer in the CDM.

In spite of the formal political intentions regarding technology transfer in the CDM contained in the Kyoto protocol, the Marrakech accords, and more, the current regulatory system under the CDM executive board does not regulate or control this subject. The interpretation by the Malaysian CDM approval system concerning technology transfer, which is echoed in the relevant PDD’s, has been quite straightforward and much less demanding to evaluate than initially formulated in the national criteria’s. This reflects, inter alia, the wish to avoid upholding unnecessary barriers to further implementation of CDM projects in Malaysia. As this may be a common interest and prioritisation for other Non Annex 1 countries DNA’s, a central subject for further case studies may therefore be to reveal whether this situation is identical in other countries, sectors, and technologies. Furthermore, although the findings of this thesis are primarily relevant for the specific Malaysian context these may also be tested for its replicability in additional case studies in different Non Annex 1 countries. In this regard, there is a noticeable lack of studies that in detail and through field studies concentrate on the processes related to technology and knowledge transfer in the CDM and the concrete actors involved. Efforts to engage the private sector, including technology providers, in GHG mitigation activities in Non Annex 1 countries may therefore benefit from studies focusing on the micro–level. In relation hereto, political negotiations to decide on the basic outlay of a new climate change regulatory regime and in this regard to revise the present, including the regulatory system of the CDM, is currently proceeding, and is expected to continue until the COP 15 meeting in Copenhagen in 2009. Therefore, there seems to be a basis for conducting further case studies in order to reach a more generic understanding of technology transfer in the CDM as this is currently taking place. This may contribute to provide a necessary background for revising the CDM system and/or to decide on provisions concerning technology transfer in future mechanisms that involve GHG mitigation activities in developing countries.

8. Perspectives

The subject of technology transfer from Annex 1 countries to Non Annex 1 countries has increasingly entered the top of the international political agenda in the negotiations concerning a post 2012 climate change regime. It seems plausible that an emission reduction crediting mechanism similar to the CDM, although most likely in a modified version, or other market based approaches, will continue to exist, which involve GHG mitigation activities in developing countries. The interesting question in this regard concerns how requirements and provisions concerning technology transfer should be formulated, operationalised, enforced, verified, and integrated in an institutional and regulatory system. Within the UNFCCC framework, the expert group on technology transfer (EGTT) is currently developing performance indicators to regularly monitor and evaluate the effectiveness of technology transfer under the convention. These are to be presented at the COP 15 meeting in Copenhagen in 2009. Although it remains to be seen how technology transfer in this context is conceptualised, these indicators may influence the formulation of technology transfer requirements in relation to a revision of the regulatory system of the CDM. If technology transfer is to be a key priority in a reformed (post 2012) CDM, the provisions may require comprehensive assessments and accordingly allocation of resources to undertake the procedural activities associated herewith. Alternatively, the requirements may continue to exist as more non–binding and optional provisions, as this presently seems to be the case in the CDM. In this regard, technology transfer as one objective ultimately needs to be balanced with other aims, including the aspiration to increase the volume of GHG mitigation activities, especially if technology transfer requirements potentially constitute an obstruction to further these activities.

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10. Appendixes

1. Overview and status of the CDM project pipeline.
2. Projects initially taken into consideration.
3. The recorded interviews pertinent to the cases analysed in chapter 5.
4. Company and project presentation papers.

5. Topics of discussion – Vyncke Energitechniek N.V.
6. Interview guide Mr. Vincent Weyne.
7. Interview with regional sales manager Mr. Vincent Weyne from Vyncke Energitechniek N.V.
8. Topics of discussion – Kyoto Energy Pte. Ltd.
9. Interview guide Mr. P. Krishnamurthy.

10. Topics of discussion – ENCO Systems Sdn. Bhd.
11. Interview guide ENCO Systems Sdn. Bhd.
12. Interview with the managing director Mr. Allen L. C. Ng., executive director Mr. Ir. Chee Teck Hee and project engineers Mr. Ben Chin Hong Sing and Mr. Tsen Wee Yew from ENCO Systems Sdn. Bhd.
13. Interview guide Mr. Faisal Abdul Rahman.
14. Interview guide Mr. Øjvind Toftgaard.

15. Interview guide Mr. Malcolm Lefcort.
16. Topics of discussion – Jebsen & Jessen Technology Sdn. Bhd.
17. Interview guide Mr. Albert Cheong.
18. Interview with senior manager Mr. Albert Cheong from Jebsen & Jessen Technology Sdn. Bhd.
19. Interview guide Mr. Benedito Carlos Stollai.

20. Topics of discussion – United Plantations Bhd.
21. Interview guide Mr. Carl Bek Nielsen.
22. Interview guide Mr. Low Yong Heng.
23. Interview with the manager of the finance division Mr. Low Yong Heng from Vickers Hoskins Sdn. Bhd.

24. Interview guide Mr. Frans Teisen.
25. Topics of discussion – Q2 Engineering Sdn. Bhd.
26. Interview guide Mr. Low King Hserng.
27. Topics of discussion – Southern Waste Management Sdn. Bhd. (SWM)
28. Interview guide Mr. Koay Chuen Hoe.
29. Interview with the project engineer Mr. Koay Chuen Hoe from Southern Waste Management Sdn. Bhd.

30. Topics of discussion – the Ministry of Natural Resources and Environment in Malaysia
31. Interview guide the Ministry of Natural Resources and Environment in Malaysia.

32. Topics of discussion the Malaysian Energy Centre.
33. Interview guide the Malaysian Energy Centre.