

**CLIMATE TECHNOLOGY TRANSFER AT THE
LOCAL, NATIONAL AND GLOBAL LEVELS:
ANALYZING THE RELATIONSHIPS BETWEEN
MULTI-LEVEL STRUCTURES**

DISSERTATION

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LIST OF ABBREVIATIONS

AAU	Addis Ababa University
ACES	American Clean Energy and Security Act of 2009
ADA	Austrian Development Agency
ADC	Austrian Development Cooperation
AFD	French Development Agency
AIJ	Activities Implemented Jointly (UNFCCC)
ANT	Actors Network Theory
AWG-KP	Ad Hoc Working Group on Further Commitments under the Kyoto Protocol
AWG-LCA	Ad Hoc Working Group on Long-term Cooperative Action under the Convention
AWGs	Ad hoc Working Groups (UNFCCC)
BAP	Bali Action Plan
BASIC	Brazil, South Africa, India and China
BICS	Brazil, India, China and South Africa
BMZ	German Ministry for Economic Cooperation and Development
BRICS	Brazil, Russia, India, China and South Africa
CCS	Carbon Capture and Storage
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CGCOC	Chinese Construction Group
CMP 5	Parties to the Kyoto Protocol
CNM	China National Materials
CNMC	China Non-Ferrous Metals Mining Corporation's
COP	Conferences of the Parties (UNFCCC)
CPC	Communist Party of China
CRBC	China Road and Bridge Corporation
CREEC	China Railway Eryan Engineering Group Co. Ltd.
CRGE	Ethiopia Climate Resilient Green Economy
CTCN	Climate Technology Centre and Network
EB	Executive Body (UNFCCC)
EEPCo	Ethiopian Electric Power Corporation
EFFORT	Endowment Fund for the Rehabilitation of Tigray
EGTT's	Expert Group on Technology Transfer's (UNFCCC)
ENKA	Turkish Construction Company

EPA	Environmental Protection Authority
EPACC	Ethiopian Program of Adaptation to Climate Change
EPC	Engineering, procurement, and construction
EPRDF	Ethiopian People's Revolutionary Democratic Front
EREDPC	Ethiopian Rural Energy Development and Promotion Center
ESTs	Environmentally Sound Technologies
EU	European Union
FDI	Foreign Direct Investment
GCF	Green Climate Fund
GEF	Global Environment Fund
GHGs	Greenhouse Gases
GGs	Green growth strategy
GIZ	German Society for International Cooperation
GNP	Gross national product
GoE	Government of Ethiopia
GTP	Ethiopian Growth and Transformation Plan
HR	Human Resource
HCIE	HYDROCHINA Engineering Consulting Co., Ltd.
ICBC	The Industrial and Commercial Bank of China
IPCC	Intergovernmental Panel on Climate Change reports
IPR	Intellectual Properties Rights
IT	Intermediate technology school of thought
KOPIA	Korean Project on International Agriculture
KP	Kyoto Protocol
LCA	Long-term action group
LDCs	Least developed countries
LEG	Least developed country Expert Group
MCTF	Multilateral Clean Technology Fund
MEAs	Multilateral environmental agreements
MoST	Ethiopia Ministry of Science and Technology
MRV	Measuring, reporting and verification
NAPAs	National adaptation programmes of action
NGO's	Non-governmental organizations
NIEO	New International Economic Order
NSC	North South Cooperation
NSCTT	North-South climate technology transfer

NSSCTT ¹	North-South-South climate technology transfer
ODA	Official development assistance
OECD	Organisation for Economic Co-operation and Development
PLC	Portland Limestone Cement
QCX	Quality Control by X-Ray
REs	Resident Engineers
REDD+	Reducing Emissions from Deforestation and Forest Degradation
R&D	Research and Development
SBI	Subsidiary Body for Implementation (UNFCCC)
SBSTA	Subsidiary Body for Scientific and Technological Advice
SSC	South South Cooperation
SSCT	South South climate technology transfer
TAC	Theory of absorptive capacity
TAPs	Technology Action Plans
TCDC	Technical Co-operation among Developing Countries
TEC	Technology Executive Committee (UNFCCC)
TNAs	Technology Needs Assessments
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UK	United Kingdom
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USA	United States of America
WBCSD	World Business Council for Sustainable Development
WTGS	Wind turbine generating systems
WTO	World Trade Organization

¹ NSSCTT for this thesis means a process whereby climate technology from one or more global north and south countries is transferred to a southern country.

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DEDICATION

This dissertation is dedicated to the loving memory of my dear father, Tessema Abissa, who passed away during the last stage of the thesis. He was the reason I am. Thank you for quietly teaching me to be everything you were, not by preaching, but by example. Your honesty and integrity were unparalleled and pure and came from the heart.

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

International climate technology transfer serves a broad set of different purposes covering global climate goals, national development aspirations, and companies' profit motives. It is affected by socio-political and technical factors at different levels (global, national and local) where different entities intervene and influence the processes (Byrne et al. 2010). International climate technology transfer is shaped and reshaped by the decisions made at multi-level structures (international discourses, national policies, and firm practices). A change occurring at one level affects the technology transfer at other levels through either top-down or bottom-up processes. Research is needed to revisit and reinterpret existing theories and empirical evidence targeted directly at understanding the considerations which characterize climate technology transfer at the intersection of international climate policy, national development aspirations and firm level profit motives. A study into multi-level processes should provide information on the synergies of decision-making structures, and be based on analytical analysis of socio-political and technical factors.

This doctoral thesis is a response to the need for an academic contribution to fill a knowledge gap in the understanding of international climate technology transfer by examining relationships between multi-leveled decision structures for climate technology transfer. The PhD study (a) considers new phenomenon in developing countries, (b) looks at the different actors and the specific modalities of transfer and, (c) locates climate technology transfer as a response to climate change at the interface between relationships of the multi-leveled decision making structures: firm practices, national policies, and international discourses.

The motivation for this doctoral thesis includes the following four components.

Firstly, the thesis is responding to rapidly changing knowledge in the understanding of international technology transfer. The subject of technology transfer is not new to scientific researchers and practitioners; however, current global discussions, the national approaches and local practices of technology transfer need to respond to at least three key changes:

(a) The effort of combating climate change has brought the international technology transfer discussion into the center of global debate and national development focus. Climate change requires a global response, encompassing the North and the South, local and global

communities, and public and private sectors. There is broad agreement among politicians, practitioners and researchers on the critical role of international technology transfer for effective global response to the climate change challenges, involving both mitigation measures and adaptation activities (Bell 2012; Forsyth 1998; Heaton et al. 2000; MacDonald 1992).

(b) A number of developing nations have become much more technologically sophisticated. While developed countries account for the bulk of innovation even in climate technologies, large emerging economies such as China, India and Brazil are already among the leaders in some areas of technology. There are major changes in the numbers of trained scientists and technologists, the level of science-based industry, and the magnitude of national scientific research and financing programs (Dechezleprêtre 2010; Baron 1993). This change is, of course, greater for the middle-income nations and much weaker for poor nations. There is, therefore, wide heterogeneity across developing countries themselves. The difference in economic advancement and technological sophistication among developing countries has enabled the flow of technology from one developing country to another through south–south cooperation. Today, the transfer of climate technologies between developing countries is not only an attractive suggestion for possible evolution of the current exchange of knowledge, but also represents an important reality in technological cooperation across countries.

(c) The world is now globalized in the sense that free trade has spread and, in many industries, economies of scale now favor production facilities that serve more than one nation. In the era of globalization governance, issues have moved to a global level in response to a growing recognition of planetary interdependence. Globalization has improved access to technological latecomers to advanced technologies. It reduces the technology gap and has raised the level of productivity in developing countries (Archibugi and Lammarino 1999; Helpman and Hoffmaister 1997). However, fulfilling the promise for fostering less crisis-prone, more climate resilient, and more sustainable globalization is still a concern for the promotion of appropriate technology transfer.

Secondly, this doctoral thesis responds to the urgent need to act on climate change by providing empirical evidence on the relationships between the three levels of decision making structures: international climate policy debates, national development approaches, and local implementation. The interconnection between the three levels of decision-making structures for climate technology transfer is important to help avoid irreversible changes associated with dangerous levels of human-induced climate change. There is a need to systematically examine the multi-leveled decision processes for technology transfers that are important for meeting climate change mitigation and adaptation goals. However, the literature

specific to climate technology transfer is relatively recent, and does not focus on the interplay between multiple levels (Dechezlepretre et al. 2011; Doranova et al. 2010; Schneider et al. 2010; Seres et al. 2009; Youngman et al. 2007). Studies on transfer of climate technologies are vital for informed global debates and evidence-based local decisions for more timely and direct responses to the specific challenges raised by climate change. Analysis on the extent to which local level climate technology transfer practices are reflected at the international climate policies, and the level of inclusion of international agreements in national policies and firm level practices, is vital for effective transfer of climate technologies to mitigate climate change.

Thirdly, the research presented in this thesis attempts to contribute to the efforts for rapid transition of low carbon climate resilient development pathways in developing countries through the understanding of relationships between the three levels of decision-making structures for climate technology transfer. Achieving significant greenhouse gas (GHG) emission reductions requires new technologies everywhere, especially in developing nations, which need to both slow their GHG emission growth rate and to improve their economic futures (Ockwell et al. 2008; Ockwell and Mallett 2012). The latter is a priority that can be at the expense of increased GHG emissions without appropriate environmentally sound technologies. Technology transfer, therefore, needs to address concerns about development priorities in host countries.

Analysis of development priorities and approaches of developing countries in the context of international climate technology transfer includes investigating the rapidly changing realities in developing countries. These changes encompass increasingly sophisticated technological advances, emergence of south-south technology transfer as a new paradigm for technology flow, and the rise of developmental state (or state capitalism) as a political philosophy. These new realities and phenomena in developing countries coupled with the drawn out global climate policy debates have made the process of climate technology transfer more complex.

It is, therefore, important to conduct an analysis that will assist efforts for a rapid transition to climate-smart development. The analysis should consider recent changes in developing countries, and look at national climate-smart development aspirations in relation to coherency and comprehensiveness of global climate policy.

This thesis emphasizes the role of developing countries, and in particular emerging economies, as sources as well as recipients of international technology innovations. Despite wide recognition of the economic advancement and technological sophistication of certain developing countries, these changes in relation to international technology flow, have

received relatively little attention in academic research and have no coherent international policies under the UNFCCC.

Fourthly, existing empirical studies on international climate technology transfer provide mixed evidence on the role of international climate change discussions under the UNFCCC in presenting opportunities for local firms' technological advancement and informing national climate-smart development pathways (Ott et al. 2008; Forsyth 2007; Branstetter et al. 2005; Ockwell et al. 2008).

This research attempts to provide some evidence to help reconcile the difference in empirical evidence by exploring the link between the three levels of decision-making structures for climate technology transfer. The research elucidates the reasons for both good accords and disjunctions between international climate technology transfer debates under the UNFCCC, national policies and priorities for climate-smart development and firm level technological advancement and transfer.

Technology transfer as an instrument to mitigate environmental problems and adaptation to climate change has featured prominently in many of the much-debated global climate change discussions. The Bali Action Plan¹, agreed at the COP 13 of the UNFCCC in 2007, reaffirmed the centrality of technology transfer to increase climate adaptation and mitigation capacities of developing countries. It has also made technology transfer one of four pillars (the other pillars are mitigation, adaptation, and financing) of a new climate agreement (Cléménçon 2008). The Intergovernmental Panel on Climate Change reports (IPCC 2007 and 2012) concluded that any stabilization of GHG concentrations is not possible without technological innovation and transferring new technologies and practices within countries and across national borders. The importance of technology transfer in solving climate change is also reflected in the integration of a number of articles stipulating technology transfer within the UNFCCC and has been underlined in various policies and academic texts. The UNFCCC requires parties to, "promote and cooperate in the development, application, diffusion, including transfer, of technologies, practices, and processes that control, reduce, or prevent anthropogenic emissions of greenhouse gases (UNFCCC 1992)." Moreover, economic and social benefits are associated with the transfer of technologies. In Agenda 21, a blueprint for sustainable development agreed upon by 178 countries at the United Nations Conference on Environment and Development (UNCED), technology transfer is seen as a significant potential instrument of sustainable development (UN 1993).

¹ For more information on the Bali Action Plan, please refer Section 2.3.2.

1.2 PURPOSE, SIGNIFICANCE, AND SCOPE

This thesis aims to examine the relationships between the multi-level decision structures for climate technology transfer through a combination of top-down macro policy analysis and bottom-up micro implementation analysis.

In order to analyze these relationships, the thesis locates the issue of technology transfer as a response to climate change at the interface between three components: (1) technology transfer issues that have always been at the forefront of the global climate change debate, (2) the objective of technology transfer for achieving low-carbon climate resilient national socio-economic development aspirations and (3) the effectiveness of technology transfer at the firm level for decreasing GHG emissions and transfer of environmentally sound technologies to mitigate climate change. These three components are elaborated in the following section.

(1) Climate technology transfer in the global climate change policy debates (Chapter 4 of the thesis). The need for enhanced capabilities for meeting the challenges of mitigating climate change has made technology transfer a high priority on the international development agenda as well as in climate change negotiations. The international community has recognized the vital importance of technology transfer in mitigating climate change. The international panel on climate change (IPCC) reported that without technology transfer it might be difficult to achieve emission reductions at a significant scale (IPCC 2007). Technology transfer has been used as a means of international cooperation and a concrete approach to GHG mitigation has been at the center of climate policy debates. In this regard, the UNFCCC and the Kyoto Protocol required Parties to promote and cooperate in the development and transfer of technologies that control, reduce, or prevent GHG emissions. The UNFCCC has been a major institutional setting for potential international cooperation on climate change. Climate change discussions and initiatives under the UNFCCC have stressed the need for cooperation between developed and developing countries for the promotion of technology transfer.

This thesis analyzes the substances and processes of the 2009 UN Climate Change Conference (COP 15) in Copenhagen and reviews policy positions of selected countries on international climate technology transfer. It examines what the outcome might mean for facilitating international transfer of climate technologies, and investigates causes for the lack of ambitious international climate technology transfer agreements. The Copenhagen summit brought together 115 Heads of State and Government, and was widely reported as the largest high-level gathering for climate change discussion. The Copenhagen Climate Change

Conference raised climate change policy to the highest political level. No other conference has featured an international agenda on climate change so prominently as COP 15 (Harvey 2009). In the Conference, the negotiators were engaged with a fundamental political bargain directly involving technology transfer. However, deep divisions between developed and developing countries affected the bargaining processes and quality of its outcome. The Copenhagen conference set in motion particular negotiating positions, focuses and strategies. These are relevant to the other ongoing international climate policy debates under the UNFCCC. The thesis examines the origin and structure of different countries' incompatible preferences and bargains under the UNFCCC, and explores the implications for transfer of climate technologies at national and local levels.

(2) Climate technology transfer at the national level (Chapter 5 of the thesis). Technologies have been a driver of economic and social development worldwide, but not all countries have had the capacity to develop and maintain the technologies they require. In climate change negotiations one of the key issues has been enhancing developing country access to climate change technologies for environmentally sound economic development (Maskus and Okediji 2010). Achieving low-carbon national socio-economic development is a primary objective of technology transfer for developing countries. There is widespread consensus that diffusion of knowledge and technologies is essential for economic growth and prosperity (Grossman and Helpman 1991; Romer 1990) and developing countries have the potential to industrialize on the basis of environmentally sound technologies as opposed to conventional ones (Ockwell and Mallett 2012).

A developed-developing countries, north-south gap, historically characterizes technology ownership (Missbach 1999), with developed countries having a technological advantage. However, emergence of several developing countries as leading manufacturers and developers of low carbon technologies, and flow of technologies between developing countries, has challenged the traditional characterization of developed-developing, north-south transfer as the only form of technology transfer (Brewer 2008).

This thesis analyses the potential, characteristics, and relevance of south-south cooperation as the new technology transfer paradigm for international environmentally sound technology transfer, emphasizing the role of developing countries as both sources and recipients of technology innovations. The evidence for this part of the thesis on the South-South climate technology transfer (SSCT) was provided through analysing the case of Ethiopia.

(3) Climate technology transfer at the local (firm) level (Chapter 6 of the thesis). Effective transfer of climate technologies at the local (firm) level to the Global South is one of the responses to the complex challenges of mitigating climate change (IPCC 2000 and 2007). As most technology is held in firms, firms are the most common technology suppliers, as well as the most common recipients (Patel and Pavitt 2000). Effective technology transfer at the firm level requires 'dual embeddedness' on the part of the affiliate, i.e. embeddedness in both local firms and international companies (multinational corporations), hence the combination of local and international knowledge transfers (Frost 2001). As a continuation of the national level analysis (Chapter 5), the firm level study also analyses the case of Ethiopia as a host for technology transfer, with other developing countries as well as developed countries, as sources. The thesis provides information on the effectiveness of the north-south climate technology transfer (NSCTT), south-south climate technology transfer (SSCTT) and north-south-south climate technology transfer (NSSCTT).

The thesis compares and contrasts SSCTT, NSCTT and NSSCTT by examining the characteristics of networks, quality relationship of actors, performance of actors' network and the critical factors of firms' ability to value new external knowledge. The thesis also explores internalization of new external information and the ability to utilize external knowledge. The thesis gauges effectiveness of the three modalities of cooperation for enhancing technology transfer at the firm level. It investigates the effectiveness of technology transfer at the firm level in terms of the distinct and combined effects of a firm's network and absorptive capacity for technology transfer.

SCOPE OF THE THESIS:

The thesis focuses on analyzing the transfer of established technology from one operational environment to another (horizontal transfer). International technology transfer here denotes the geographical relocation of technology from one country to another. The thesis does not look at vertical technology transfer, which occurs when knowledge is transmitted from basic to applied research, and from there to development and production. The empirical analysis covers the horizontal technology transfer both from global north countries to global south countries and technology transfer within the global south countries.

The thesis uses the term, "Climate Technology Transfer" to refer to technology transfer for minimizing greenhouse gas emissions and adapting to climatic variability as well as climate change. It characterizes international policy debates on the issue and national policies for promoting international technology transfer. In other studies, technologies for reducing GHG emissions have often been termed "Low carbon technology transfer". This implies that the aim of the technologies is primarily for reduction or substitution of GHGs, but

not adapting to climatic variability (MacKerron et al. 2008). However, there is broad agreement among academicians, politicians, and practitioners on the importance of international technology transfer in combatting climate change, involving not only mitigation measures but also adaptation activities (Bell 2012; Forsyth 1998; Heaton et al. 2000; UNEP 2001). Technology transfer is an encompassing notion in climate change policies because mitigation and adaptation both require technologies. Technology transfer as an encompassing theme in policy discussions of climate change related “transfer of technologies” is identified in the text of UNFCCC as the means for mitigating GHG emissions and adapting to the impacts of climate change (UNFCCC Articles 4, 9, and 11).

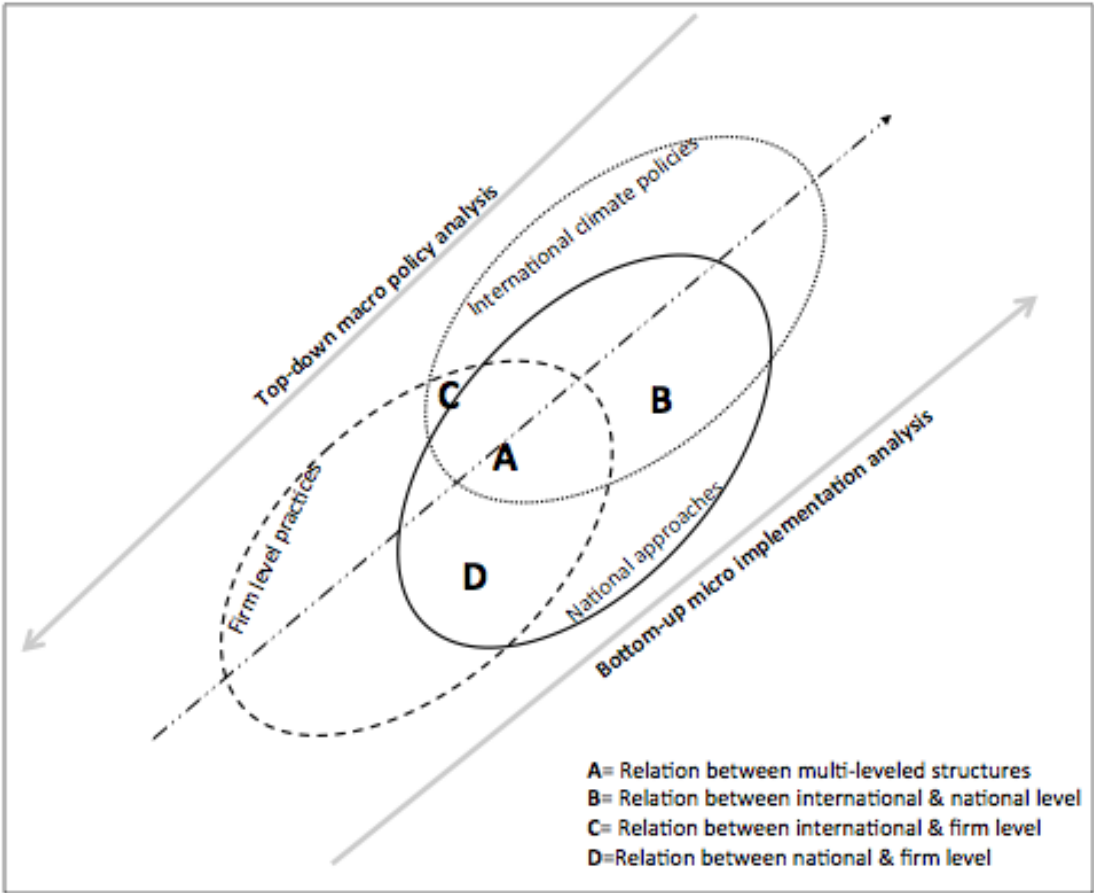
Defining climate technology transfer is complex and there are many academic controversies surrounding it. However, it is not the intention of this doctoral thesis to engage in complex terminological discussions. Questions on the meaning of climate technologies do not only arise in the technology transfer context, but also with respect to the broader dilemmas of how to address the problem of climate change. This thesis adopts the more popular and balanced definition given by the IPCC as its working definition. This definition is also embodied in the UNFCCC technology transfer framework. Technology transfer is 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, non-governmental organizations (NGOs) and research/education institutions ... the broad and inclusive term “transfer” encompasses diffusion of technologies and technology cooperation across and within countries. It covers technology transfer processes between developed countries, developing countries, and countries with economies in transition. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies” (IPCC 2000, p 3).

1.3 RESEARCH QUESTIONS

The overarching research question investigated in this thesis is located in the context presented in the preceding sections. The historical controversies over climate technology transfer are perpetuated within global debates about combating impacts of climate change that challenge the optimistic vision of eradicating poverty, as embodied, for example, within the Millennium Development Goals. Hence, it becomes not only an interesting area for academic research, but also urgent to better understand how far the central tenets of international climate technology transfer debates are informed by, and reflected in, national policies and approaches as well as technology transfer practices at the firm level.

This doctoral thesis aims to analyze synergies of the multi-level structures of climate technology transfer to explore interconnections between decisions made at the three levels: international, national, and firm. In a sense, the thesis combines top-down macro-policy analysis with bottom-up micro-implementation analysis. For a more comprehensive understanding of the research framework of this study, refer to Figure 1.1.

FIGURE 1.1 RESEARCH FRAMEWORK DIAGRAM



The research framework diagram, Figure 1.1, examines the relationships between the multi-levelled decision structures for climate technology transfer (area A in Figure 1.1), through a combination of top down macro policy analysis and bottom up micro implementation analysis (the Y-axis and X -axis respectively in Figure 1.1).

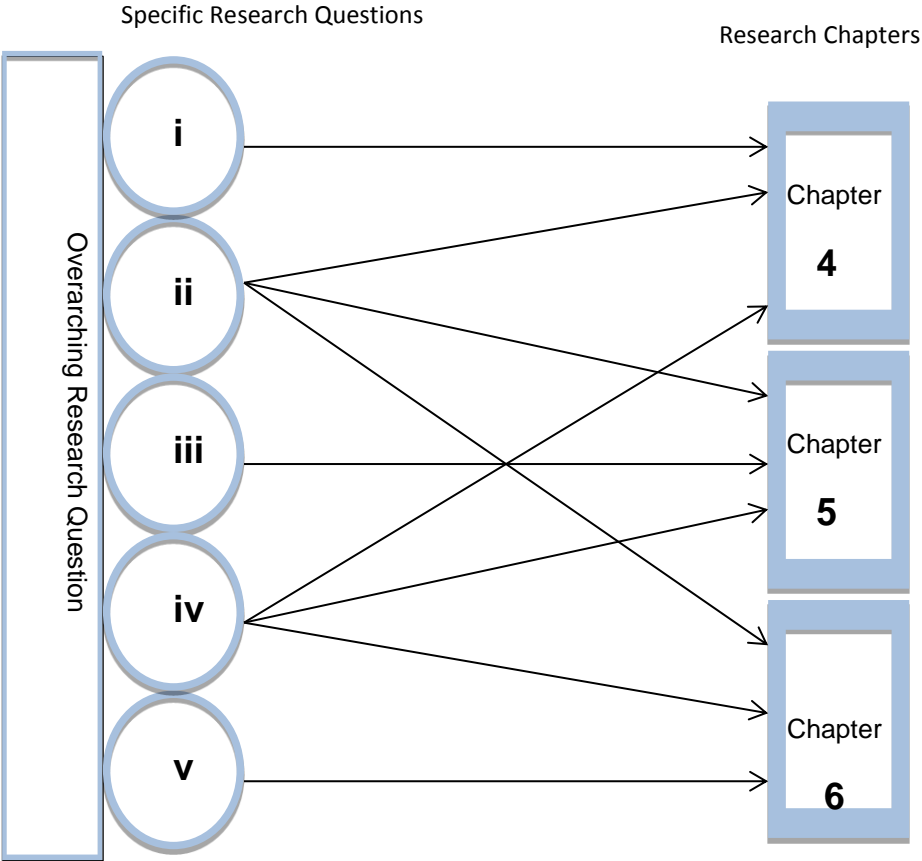
In order to analyze these relationships, the thesis locates climate technology transfer as a response to climate change at the interface between the three relationships: the relationships between international and national level (area B in Figure 1.1), between international and firm level (area C in Figure 1.1) and national and firm level (area D in Figure 1.1). The area

indicated as A, B, C, and D describes the relationships that may exist between the three levels. In order to assess the quality of these relationships, the research employs a combination of both top-down and the bottom-up analyses².

The thesis seeks to answer the following twinned overarching questions:

1. *What is the relationship between firm practices, national policies, and international discourses for climate technology transfer?*
2. *If there is a disjunction, then why?*

FIGURE 1.2 MAPPING RESEARCH QUESTIONS



Based on these overarching research questions, the following specific research questions were used to guide the empirical component of the thesis:

² For more information, please see Section 3.1 and Figure 3.2 about the “iterative explanation building” technique, which reflects the combination of the top down macro policy analysis and bottom down micro implementation analysis.

- i. What is the origin and structure of a country's' incompatible preferences and bargains at the international climate policy negotiations? Why did they fail to reach ambitious climate technology transfer agreements?*
- ii. How relevant are country's incompatible preferences and bargains in shaping national policies and firm level technology practices?*
- iii. What is the nature of collaboration between developing countries for promoting climate technology transfer at the national level vis-à-vis the North-South technology transfer?*
- iv. How far do national approaches for climate technology transfer match countries' positions under the UNFCCC and actual local practices?*
- v. How effective are the international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing the transfer of climate technologies at the firm level?*

These research questions are addressed in each of the three research chapters: Chapter 4, 5 and 6 as presented in Figure 1.2.

1.4 STRUCTURE OF THE THESIS

This dissertation is structured as follows:

Chapter 1 begins with a section about the motivation behind the doctoral thesis. It also introduces and contextualizes the research and the research questions, and justifies the choice of topic and problem in terms of its theoretical, analytical, and methodological relevance.

Chapter 2 reviews the work that has already been done on the dissertation topic, both theoretical and practical. The literature reviewed includes concepts, literature on international climate technology transfer, national policies and approaches, and that assessing effectiveness of climate technology transfer at the firm level. It summarizes knowledge gaps in the existing literature and describes the value of the dissertation. The introductory section includes definitions, frameworks, and models as presented in the literature and presents trends in international climate technology transfer. The second section reviews literature on climate technology transfer in international climate policy, including that on multilateral environmental agreements, international technology transfer under the UNFCCC and technology transfer in international economic legal instruments, such as the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). The third section covers literature on national economic policies and technology transfer. It presents the literature in five categories: (1) the role of international climate technology transfer for enhancing national

economic development; (2) the role of government and national policies in accelerating transfer of climate technologies; (3) south-south technology transfer; (4) Ethiopian climate change policies and strategies; (5) overarching theories to examine the relevance of south-south technology transfer. The fourth section presents literature on firm level technology transfer. This section also includes literature on a firm's motives for international technology transfer. The different approaches, methods, indicators and overarching theories in the literature regarding measuring technology transfer at the firm level, are also presented in this section. The final section in Chapter 2 describes the gaps in knowledge identified in the literature review that this doctoral research tackles. This section presents three major ways that this thesis differs from preceding studies. First and foremost, it emphasizes the interconnections of the multi-level structures of climate technology transfer. Second, it emphasizes the dynamic aspects of international technology transfer, rather than the static aspects. Third, the dissertation recognizes national realities and new paradigms and analyzes their implications for accelerating the transfer of climate technologies. Lastly, this doctoral thesis focuses on giving a broader picture of climate technology transfer through empirical evidence from a smaller-scale unit: firm level technology transfer. The study builds on the comprehensive notion of climate technology transfer by providing information on the synergies of decision-making structures. The results provide an analysis of socio-political and technical factors at different scales and how the different entities intervene and influence the decision-making processes.

Chapter 3 presents the overall methodological approach and how the gaps in knowledge are converted into research questions and the type of method that is needed to tackle each of them. A qualitative explanatory research method, including a combination of case study, survey, and observation research methods, was employed to answer the research questions. The major data collection methods used in this thesis were: survey, observation, and case study. Three units of analysis of the research are identified: (1) preferences of developed and developing countries to international climate technology transfer under the UNFCCC; (2) national approaches to international climate technology transfer; (3) international technology transfer practices at the firm level.

The data analysis follows a process of “iterative explanation building” and analysis in each unit took place concurrently with data collection. The thesis employs a mix of theories and schools of thought as a framework for examining the processes of multi-level international climate technology transfer. The last section of the chapter covers reliability and validity issues, emphasizing triangulation of data from multiple data sources.

Chapter 4, 5, and 6 address each unit of analysis and present the data collected and detailed results. In these chapters, salient findings are presented, interpreted and connected with supporting data provided as appropriate.

Chapter 4 investigates the causes for the lack of ambitious international climate technology transfer agreements and examines the origin and structure of the countries' incompatible preferences and bargains under the UNFCCC. The analysis focuses on the 2009 Copenhagen Climate Conference and reveals that the negotiators were engaged in a fundamental political bargain directly involving technology transfer, and shows how deep divisions between the developed and developing countries affected the bargaining processes. The chapter concludes that causes for the deep divisions between the global North and South countries, and the reasons incompatible preferences persist, rest not in the absence of shared norms (which is the importance of combating climate change), but rather in the historical contingency implicit in the principle of 'differentiated responsibilities'. This is apparent in the Byrd-Hagel resolution, which effectively paralysed the Kyoto Protocol and led the climate bargaining process under the UNFCCC into apparently never ending circles. In terms of the negotiations in Copenhagen and subsequent meetings, the differentiated responsibilities principle has been a major sticking point.

Chapter 5 investigates the potential and relevance of south-south cooperation for international climate technology transfer. The evidence indicates that technological cooperation of least developing countries (LDCs), such as Ethiopia, with developed countries is diminishing and is being overtaken by cooperation with the global south. However, the research concludes that growing South-South climate technology transfer (SSCT) is not an alternative to North-South climate technology transfer (NSCTT), rather it is an important adjunct to North-South cooperation in order to promote the flow of technology to developing countries. The research did not find indications from policies or practices that environmental wellbeing is a motivational factor for south-south climate technology transfer. Neither was political solidarity of the global south countries in international climate regimes a major motivating factor for south-south climate technology transfer. Key findings from the chapter are that south-south climate technology transfer is characterized by (1) lack of environmental objectives because of its "Business is Business" approach; (2) lack of support for improvement of the transferee institutional infrastructure; (3) limitations in private sector involvement as an engine of innovation because of the rise of state capitalism; (4) limited interaction of firms on the supply chain; and (5) limitations in reversing the unfair North-South trade relationship. These limitations highlight the need for adequate and effective policies for

maximizing the net benefits of transferees and ensure a “win-win” outcome of the technological cooperation. Also it found that South-South climate technology transfer has a development dimension, and has the potential to make a difference in critical development areas.

Chapter 6 examines effectiveness of North-South (NSCTT), South-South (SSCTT) and North-South-South (NSSCTT) climate technology transfer through a firm’s ability to access information and ability to utilize knowledge obtained from external sources. The three modes of cooperation show distinct characteristics and result in dissimilar levels of effectiveness in technology transfer. Technological capacities occur in all three modes of cooperation, but at different levels. The results show the complementarity nature of NSCTT and SSCTT and ratified NSSCTT as an important way of strengthening effectiveness of this complementarity and fostering technology transfer by leveraging the best features of NSCTT and SSCTT. The research found that the NSSCTT was the more effective modality of cooperation for enhancing climate technology transfer, because it combined the comparative advantages of both SSCTT and NSCTT. However, some limitations in the NSSCTT were also revealed. Identifying the common interests of the three actors (The North, South and the host country) places additional demands on the management capacity of all the actors, in particular on the host country, to ensure each actor plays its designated role effectively.

Chapter 7 is the concluding chapter. It reviews the preceding chapters, bringing the results together in order to answer the central research question and reflect on the findings of the analysis. Furthermore, it elaborates on the empirical and policy implications of the study, its limitations, and suggests areas for future research. The thesis concludes, in relation to the research question, that the three levels (international, national and local) are more loosely interconnected than is necessary for effective climate technology transfer. It reveals that there is a relatively good accord between the international climate technology transfer discourses under the UNFCCC and national technology transfer policy. There is also good concurrence between national policy and firm level climate technology transfer practices. However, there is a clear disjunction between the international and local level. The interplay between top-down and bottom-up processes has resulted in a mix of coherent and incoherent relationships between the three levels.

Theoretical Framework: The thesis uses three different theoretical approaches to explain the dynamics of climate technology transfer at the interplay between international climate

politics, national climate smart development pathways and local contexts for climate technology transfer.

International regime theories are the main theoretical lens used in Chapter 4 to capture the politics of international climate change and explain bargaining processes, international rule-based co-operation, and the basic problems in global climate negotiations. No single international regime approach is adequate to explain and effectively analyse the global climate negotiations and development of the climate change regime. The solution employed in Chapter 4 is to broaden the regime model by incorporating three core concepts of the approach (power, interest and knowledge) and to build on insights offered by historical institutionalism. Historical institutionalism explains how international regimes established by countries with divergent, and often conflicting preferences, remain in place even when conditions have changed markedly. Central to this idea is that initial choices made at the foundation of a new institutional arrangement become 'locked in' and difficult to change. In contrast, development theories were used to examine climate technology transfer at the national level in Chapter 5 of the thesis to assess the potential and relevance of south-south cooperation for climate technology transfer (SSCTT). In this chapter, national development pathways were examined in relation to international regimes.

To analyze the climate technology transfer at the firm level in Chapter 6 of the thesis, a combination of actor-network theory (ANT) and the theory of absorptive capacity (TAC) was employed to examine the effectiveness of technology transfer. The use of ANT highlights the importance of access to information for technology transfer, whereas TAC centers on examining actors' ability to integrate the information and knowledge into their processes and routines.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

The international transfer of technologies in the context of climate change is a topic that has been addressed in both academic studies and literature such as technical reports or working papers. Scholars and practitioners from a variety of academic backgrounds, such as economics, political science, international law, business and management, engineering, and industrial relations have all addressed the subject, marking it out as an interdisciplinary field of study (Martinot et al. 1997)

Literature on climate technology transfer in this chapter is presented in four categories: literature that focuses on the concept of climate technology transfer, literature that deals with climate technology transfer in international climate policy, literature on technology transfer at the level of the firm, and literature related to the political economy of climate technology transfer and the role played by technology transfer in sustainable development.

2.2 LITERATURE ON THE CONCEPT OF CLIMATE TECHNOLOGY TRANSFER

Literature reviewed in this section reveals the inherent complexity of defining climate technology transfer, difficulties in making conclusions, and contentions around the concept. It indicates that various levels of decision-making structures fragment what we know about international technology transfer. This fragmentation shows the limits of existing literature in presenting empirical evidences and analytical analysis on the multi-level decision making characteristics of climate technology transfer.

There are numerous definitions of technology transfer frameworks, and models in the literature, but there is no general agreement on exactly what constitutes technology transfer or how technology transfer should be defined; and there are no coherent, overarching theories of technology transfer (Reddy and Zhao 1990). There has been a general consensus that any workable definition of technology transfer must be functional than formal. However, the specific definitions have varied. Different perspectives of technology transfer stem from different views of technology as a commodity, as knowledge, and as a socioeconomic process (Rosenberg 1982). In the field of climate technology transfer scholars or decision makers may convey varied connotations for technology transfer under different contexts.

The concept of climate technology transfer started receiving global attention during the Earth Summit held in Rio de Janeiro in 1992. The concept was later defined in an IPCC

report (2000). As mentioned in Section 1.2 the IPCC (2000) definition is a popular and balanced view of climate technology transfer. The definition presupposes the dynamic processes that ensure applicability of technologies in local contexts, full disclosure of technical information by the technology providers, and built-in sustainability measures, including continued availability of the technology, etc. Clear methodologies and approaches for Technology Needs Assessments (TNAs) and technology transfer have been set out to ensure that climate technologies address local needs of target users (UNDP 2009). Nevertheless, determining what technology should qualify poses important legal and ethical concerns.

A core challenge for technology transfer is to navigate the complexities of technological development and scientific uncertainty, whether with respect to climate change or other environmental concerns, in evaluating what technologies are appropriate. This approach, which is central to a 'needs assessment', to some extent answers the question of which technologies are appropriate for particular countries; though ambiguities remain about the term more generally. Technologies may vary in appropriateness between different contexts, but the term, climate technology transfer may suggest all technologies have similar climate benefits or are equally attractive (Bell 1997; Forsyth 1999; Heaton et al. 1991; IPCC 2000; Martintot et al. 1997; UNFCCC 2003). Questions regarding the meaning of climate technologies do not just arise in the technology transfer context, but also with respect to the broader dilemmas of how to address the problem of climate change. The international climate change agreements continue to focus primarily on implementation issues rather than core definitional issues.

Explaining the role technology transfer could play in reducing GHGs, and outlining specific mechanisms in an attempt to define appropriate technology more clearly, does not eliminate all ambiguities. For example, UNFCCC (2009) stated that climate technology transfer could provide developing countries with the capacity to install, operate, maintain and repair imported technologies, produce lower cost versions of imported technologies, adapt imported technologies to domestic markets and circumstances, and develop new technologies, whilst respecting relevant intellectual property rights. Developing countries could benefit from climate technology transfer if the technology transfer process is understood broadly to deal more fully with the demand-side aspects of innovation systems, including the political and institutional contexts of these systems, and the need to ensure that technology development proceeds on a self-determined, needs-led basis (Ockwell et al. 2008; Ockwell and Mallett 2012; Wei 1995).

International technology transfer refers, in fact, to a comprehensive notion and a range of socio-political influences, including the tacit knowledge and a broad set of processes

covering the flows of know-how, experience and equipment following different pathways, where different entities intervene and influence these processes. It is a complex process influenced by the goals and capabilities of both technology supplier and technology recipient, and involving several parties and stakeholders (Lall 1992). However, most definitions render international technology transfer as a relatively simple passing of knowledge from one institution to another (Davidson et al. 2008; Fransman 1985; Kathuria 2002; Kranzberg 1986; Ockwell et al. 2007). This knowledge is either embodied in machinery, codified in blueprints, licenses and manuals, or tacit within a person or a group (Andersen et al. 2007; Bell 1989; Bell 1997; Rosenberg et al. 1997). The knowledge is brought about through a learning process, and thus technology transfer is fundamentally a process of learning. In this view, transfer of inanimate objects, such as machines and blueprints, by itself does not constitute technology transfer, a view echoed by Rosenberg and Fritschak (1985).

Technology transfer includes transfer of patented, so-called 'hard' technology, such as equipment and products to control, reduce or prevent anthropogenic emissions of GHG in the energy, transportation, and industry sectors; and 'soft' technologies, such capacity building, information networks, training and research. It also includes transfer of unprotected or soft technology, such as know-how.

Evolutionary economists stress that in transferring knowledge some parts of the knowledge are not easily codifiable, but tacit. This makes the process of transferring knowledge between firms costly and require specific learning efforts, so the transfer of knowledge may not necessarily be successful (Attelwell 1992; Bodansky 1993). Tacit corporate technological capabilities is the antithesis of explicit knowledge, in that it is not easily codified and transferred by more conventional mechanisms such as documents, blueprints, and procedures, and must instead be internally learned, with or without external assistance (Bijker et al. 1987; Bell and Keith 1993; Chen 1996; Dahlmann et al. 1981; Newell 2008; Cantwell 2009). Tacit knowledge is derived from personal experience; it is subjective and difficult to formalize (Archibugi and Coco 2005; Cantwell 1989; Mytelka 2007; Dutrénit 2004; Nonaka 1994; Nonaka et al. 2001). Therefore, tacit knowledge is often learned via shared and collaborative experiences (Nonaka and Takeuchi 1995; Nonaka and Toyama 2002); learning knowledge that is tacit in nature requires participation and 'doing' (Kuada 2003). Because of the personal nature of tacit knowledge exchange, Roberts (2000) suggests that an important factor in this process is trust. She contends that the exchange of knowledge, and particularly tacit knowledge, is not amenable to enforcement by contract; hence, the importance of trust in the exchange of knowledge.

Roberts (2000) also argued that technological transfer could be more successful when it is between agents who share common social, cultural and linguistic characteristics. These

innovation system approaches are clearly important to facilitating transfer of technology at the firm level and focus on the production side; however, they have limitations in explaining a broader process of technological change such as international climate technology transfer for low-carbon climate-resilient development pathways.

Some literature has proposed a socio-technical transitions approach as being a broader and more ambitious way for better facilitating; promoting and enhancing the transfer of climate technology transfer (Byrne et al. 2010). A socio-technical approach combines the science and technology of devising a production, with application of the technology in fulfilling a societal function (Geels 2004). Literature on the socio-technical transitions approach has made a major contribution to understanding the complex and multi-dimensional shifts considered necessary for adapting societies and economies to sustainable modes of production and consumption. However, literature regarding the contribution of socio-technical transitions approach to the study of low-carbon climate-resilient development pathways is limited.

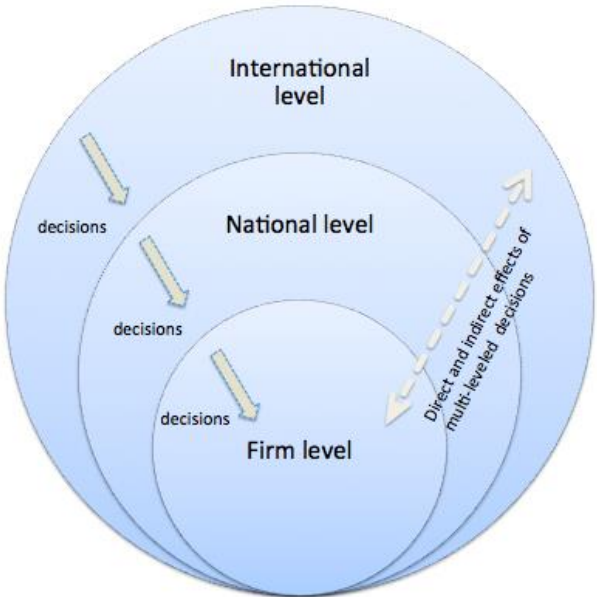
Technology transfer creates new technological capacity through technology transfers and active independent learning, creation and innovation of the recipient. Organisational learning is therefore an essential factor in the success of technology transfer. Learning processes are broader when foreign knowledge is linked to the wider structure of the host country economy through supply-side actors and demand side inter-firm linkages (Wei 1995); which in turn are strong when the host country has a network of local suppliers capable of supporting the operation and maintenance of this new foreign technology (Ivarsson and Alvstam 2005). Ockwell and Mallett (2012) argued that the innovation systems literature recognizes much of this, but tends to focus on supply-side actors and their interactions. Where the demand side is understood, it is strongest in regard to user-firms rather than final consumers.

Climate technologies are important to the south in particular because they could accelerate development by skipping inferior, less efficient, more expensive or more polluting technologies and industries and move directly to more advanced ones. It is proposed that through leapfrogging, developing countries can avoid environmentally harmful stages of development and do not need to follow the polluting development trajectory of industrialized countries (Goldemberg 1998). The diffusion and application of climate technologies provide win-win solutions to the global south countries, allowing economic growth, climate change mitigation and resilience to climate change to proceed hand-in-hand. They potentially contribute to sustainable economic development by promoting greater access to resources and technologies to people who currently have no access. The concept of environmental technologies leapfrogging highlights the possibility that developing countries do not

necessary need to follow the paths of the industrialized world to fulfill their aspiration of development.

International climate technology transfer is shaped and reshaped by the decisions made at multi-level structures (international discourses, national policies, and firm practices). The illustration on Figure 2.1 shows that decisions are made at each level (international, national and firm) and the decision made in one level has an effect on the other levels. The decisions made in each level play a part in making the transfer of technology successful.

FIGURE 2.1 THE CLIMATE TECHNOLOGY TRANSFER MULTI-LEVEL SYSTEM



However, literature on the multi-leveled characteristics of international climate technology transfer is fragmented along the different levels of decision-making structures (Reddy and Zhao 1990). Therefore, the next sections focus on literature on each of the multi-leveled decision making structures.

2.3 LITERATURE ON CLIMATE TECHNOLOGY TRANSFER IN INTERNATIONAL CLIMATE POLICY

Literature reviewed in this section shows that empirical evidence and analytical analysis on technology transfer in international climate policy focuses on analyzing the governing and regulating process. It demonstrates that the literature on climate technology transfer at the international level centers on searching for explanations to the reasons for ineffectiveness of international governances and failure to address the dynamic of technology transfer. The section indicates that the various studies conducted are solidly rooted in the early perspective of multi-lateral environmental governance. The review of literature in this section

reveals the knowledge gap in explaining the issue of technology transfers at the international level vis-à-vis other levels of decision-making structures for climate technology transfer.

The section includes literature on multilateral environmental agreements, international technology transfer under the UNFCCC and literature on technology transfer in international economic law instruments, such as the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).

2.3.1 LITERATURE ON MULTILATERAL ENVIRONMENTAL AGREEMENTS

Questions about technology transfer in the climate change debate are not new. The literature shows variations, repeats, and retreats on this issue dating from the days of the New International Economic Order (Green and Singe 1975). The Declaration for the Establishment of a New International Economic Order (NIEO), adopted by the United Nations in 1974 called for a restructuring of the international order toward greater equity for developing countries. The international legal aspects of technology transfer started to attract the interest of the international community when the new perceptions of development were examined as they related to basic needs and transfer of technology within the framework of the NIEO (Hope 1983). The NIEO acknowledges that the benefits of technological progress are not shared equitably by all members of the international community and specifically highlights that the need for and possibility of significant negotiation (Green and Singe 1975).

The issue of technology transfer has been also raised in the negotiations related to the transfer of deep sea- bed mining technology in the context of the entry into force of the UN Convention of the Law of the Sea. In this regard, Li (1994) presented a comprehensive study of technology transfer for deep seabed mining under the 1982 Law of the Sea Convention and the controversies that have arisen around it.

Prominent among the multilateral environmental agreements literature is Agenda 21 (UN 1993), which outlines several strategies for promoting technology transfer, that reflect not only the need for hardware but also for building associated local capacities. In Agenda 21, technology transfer is seen as a significant potential instrument of sustainable development. Chapter 34 of Agenda 21, entitled “transfer of environmentally sound technology, cooperation and capacity-building,” calls for access to scientific and technical information; promotion of technology transfer projects; promotion of indigenous technologies; capacity building; and long-term technological partnerships between suppliers and recipients of technology. Agenda 21 defines ‘environmentally sound technologies’ as those that ‘protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residual wastes in a more acceptable manner than the technologies for which they were substitutes’ (Agenda 21, Chapter 34). It further

explains the importance of technology transfer in this context and proposes “to promote, facilitate, and finance, as appropriate, the access to and the transfer of environmentally sound technologies and corresponding know-how, in particular to developing countries, on favorable terms, including on concessional and preferential terms, as mutually agreed, taking into account the need to protect intellectual property rights as well as the special needs of developing countries for the implementation of Agenda 21” (UN 1993:Section II 78). Some literature criticized this statement of Agenda 21 as simplistic because it overlooks the fact that most technologies are privately owned, and that offering preferential terms might undermine the commercial imperatives underlying its development. This literature emphasizes the importance of creating the proper macroeconomic and policy conditions for transfers, and then letting markets dictate technology choice and transfer modes (Guertin et al. 1993; Moltke 1992).

In 1994, the Ad Hoc Working Group on Technology Transfer and Cooperation of Environmentally Sound Technologies, formed within the UN Commission for Sustainable Development, saw the technology transfer problem as one of inadequate financial resources and limited human and institutional capacities (UN 1994). The Working Group recommended that governments and international organizations provide more financing and “improve access” to environmentally sound technologies, including clearing-houses and information systems to disseminate information. Although the Working Group recommended facilitating access to technologies in the public domain, it recognized that private-sector activity was key to technology transfer and advocated linkages between research and industry.

Positive measures to encourage the transfer of environment-friendly technology have been progressively included in multilateral environmental agreements (MEAs), like the Convention on Biological Diversity and the Montreal Protocol, that also establish a Multilateral Fund providing positive measures and a participatory approach between the different stakeholders in order to facilitate the transfer of technology (Kaniaru 2007). Similar policies and strategies were also prescribed in non-UN literature. Technology transfer under the MEAs was not successful and various studies have been conducted searching for an explanation to the failure of MEAs (Osofsky 2009; Osofsky 2010). There are at least two major factors suggested as primary reasons: ineffectiveness of the MEAs, and failure to address the dynamic of technology transfer (Pachauri 2000). In addressing the former, there have been several attempts of governing and regulating the process of international technology transfer (Ravindranath and Sathaye 2002).

2.3.2 LITERATURE ON CLIMATE TECHNOLOGY TRANSFER UNDER THE UNFCCC

Literature on technology transfer in relation to the UNFCCC can be divided into five sets. The first provides overviews of climate technology transfer discussions, including objectives of international technology transfer under the UNFCCC, and the principles of transfer (Gupta 1997; Grubb et al. 2001; Ravindranath and Sathaye 2002). The second focuses on analyzing specific measures and modes of technology transfer that could be used to transfer technology under the UNFCCC (Newell 2008; Ott et al. 2008). The third investigates whether, and how, a specific mechanism might contribute to the international transfer of climate technology (Forsyth 2005, 2007; Missbach 1999; Roberts and Parks 2007). The fourth includes a growing set of evaluation studies in relation to technology transfer and the clean development mechanism (CDM) (Cosbey et al. 2007; Michaelowa and Dutschke 2000; Wara 2008). The fifth includes literature that attempts to understand the difficulties in, and the requirements for, transferring climate technologies in general (Gupta 1997; Najam et al. 2003; Martinot et al. 1997; Missbach 1999). This particular set of literature comprises a large number of project evaluations, case studies, case study compilations, attempts to synthesize the case study literature and lessons for project design.

Technology transfer has been a key objective of UNFCCC since its inception. Article 4.5 of the Convention requires developed countries to “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.” Furthermore, Article 4.7 establishes a clear link between the extent to which developing countries will implement their commitments under the UNFCCC, and the effective implementation by developed countries of their commitments relating to financial resources and the transfer of technology.

The technology transfer discipline under the UNFCCC is, in general, inspired by the principle of ‘common but differentiated responsibility’ in the efforts to combat climate change (Bodansky 1993). Yet disagreements remain, particularly on obstacles to transfer of climate-related technologies and the types of measures that should be taken to overcome them.

Between the first conference of the parties to the UNFCCC in Berlin in 1995, and the third conference, in Kyoto in 1997, a pilot phase for climate-friendly investment took place under the name of Activities Implemented Jointly (AIJ). Some literature has claimed AIJ focused too much on relatively low-cost projects in countries that already received high-levels of foreign direct investment, leaving more costly projects to domestic governments or official development assistance (ODA) (Reid and Goldemberg 1997). Partly in response to these criticisms, in 1997, the Kyoto Protocol created the Clean Development Mechanism (CDM) as one of the three market-based mechanisms or flexible mechanisms (the other

mechanisms were Emissions Trading and Joint Implementation). But unlike the other mechanisms, the CDM was limited to investment in non-Annex I (usually developing) countries, and stated that investment should contribute to “sustainable development” in general, rather than greenhouse gas mitigation alone (Cosbey et al. 2007; Michaelowa and Dutschke 2000).

Some literature has raised questions concerning effectiveness of the CDM’s contribution to technology transfer, suggesting that the CDM did not result in a real and verifiable reduction in emissions and technology transfer from developed to developing countries (De Sepibus 2009; Lutken 2008; Moon 2008).

Debate on effectiveness of the CDM for technology transfer was partly triggered by controversy over market-based versus non-market based technology transfer (Ellis et al. 2009). The developed world, championed by the USA, reiterated their view on market based technology transfer, noting that the Kyoto Protocol places technology transfer and the market at the core of the deliberations; where-as the G77+China view market based transfer as ineffective and requiring further measures. They want specific provisions for transfer of technology, financial resources and capacity building for developing countries ensured, before any market-based measures can be considered for climate policy, as a priority (De Coninck et al. 2008).

The main method of technology transfer to developing countries is through market mechanisms, though in the context of climate technology transfer, market-based should be defined by international climate policies (IPCC 2000; Lovett et al. 2012; Morsink et al. 2011). The Bali Action Plan is a key agreement for climate technology transfer, and it specifically encourages the contracting Parties to take into consideration negotiation of proper measures for effective mechanisms and enhanced means for removal of obstacles to, and provision of financial and other incentives, for scaling up of the development and transfer of technology to developing countries (Cléménçon 2008). The Bali Action Plan is part of the Bali Road Map, which was adopted at the 2007 UN Climate Change Conference, held in Bali, Indonesia. The Road Map is a set of forward-looking decisions representing work that needed to be finalized in 2009 at the 15th Conference of the Parties (COP 15) in Copenhagen. The Action Plan defined the directions of the negotiations for a global and comprehensive post-2012 climate agreement and set out a framework for long-term cooperative action in order to reach an agreed outcome and adopt a decision at COP 15 in Copenhagen (Cléménçon 2008). In order to achieve the objectives set out in the Plan, the Conference of the Parties created the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA), tasked with conducting the negotiating process to create a successor to the Kyoto Protocol. Discussions on technology transfer in the Bali Action Plan revolved around three main

issues: institutional arrangements, performance indicators, and financing (Cléménçon 2008). To put this into perspective, the Action Plan called for “enhanced action on technology development and transfer to support action on mitigation and adaptation.” Such action would include: (1) Effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for, scaling up of the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies; (2) Ways to accelerate deployment, diffusion and transfer of affordable environmentally sound technologies; (3) Cooperation on research and development of current, new and innovative technology, including win-win solutions; (4) The effectiveness of mechanisms and tools for technology cooperation in specific sectors. Mechanisms for technology transfer recommendations were made to address four areas: innovative options for financing the development and transfer of technology, enhancement of cooperation with relevant conventions and intergovernmental processes, promotion of indigenous technology development through provision of financial resources, and joint research and development and promotion of collaborative research. The Bali Conference was widely regarded as a key next step in continuing to chart an international course to mitigate global warming and deal with its impacts (Dalindyebo 2009; Taubman 2009).

Debate over technology transfer continued at the 14th United Nations Climate Change Conference in Poznań, Poland (“Poznań Conference”), held in 2008. The conference was intended to be a significant milestone in global cooperation on climate change, marking the progress between the start of negotiations in Bali in 2007 and the conclusion of negotiations in Copenhagen in 2009. The Global Environment Facility (GEF), as an operational entity of the financial mechanism under the Convention, was requested by the COP at its thirteenth session in Bali to elaborate a strategic programme to scale up the level of investment for technology transfer in order to help developing countries address their needs for environmentally sound technologies, specifically considering how such a strategic programme might be implemented, along with its relationship to existing and emerging activities and initiatives regarding technology transfer. The GEF presented the strategic program on technology transfer in Poznań and the report was welcomed by COP14 and renamed the ‘Poznań Strategic Program on Technology Transfer’.

The Poznań Strategic Program established the following three funding windows within the GEF in support of technology transfer: (1) Conduct Technology Needs Assessments (TNAs) (2) Pilot priority technology projects linked to TNAs (3) Disseminate GEF experience and successfully demonstrated climate technology transfer. The Poznań Strategic Program on Technology Transfer was adopted as a step towards scaling up the level of investment in technology transfer in order to help developing countries address their needs for

environmentally sound technologies. As noted by Lovett et al. (2009) the 'Poznan Strategic Programme on Technology Transfer' was the major effective decision at the COP 14 on technology transfer. In addition, there was agreement on simplifying the CDM and increasing the geographical distribution of the funds, especially to Africa. However, the Parties couldn't agree on inclusion of carbon capture and storage technology under CDM (Lovett et al. 2009).

TABLE 2.1 KEY DECISIONS REGARDING DEVELOPMENTS AND TRANSFER OF TECHNOLOGIES

Key decision	Key outcomes related to transfer of technologies
Berlin Conference (Decision 1/CP.1)	Decided to review at each session of the Conference of the Parties the implementation of Article 4, paragraphs 1(c) ¹ and 5 ² , of the Convention as a separate agenda item under "Matters relating to commitments"
Buenos Aires Conference (Decision 4/CP.4)	Established a consultative process to achieve agreement on a technology transfer framework
Marrakech Conference (Decision 4/CP.7)	Adopted the technology transfer framework
Bali Conference (Decision 3/CP.13)	Reconstituted the Expert Group on Technology Transfer and adopted the set of actions as set out in the recommendation for enhancing the implementation of the technology transfer framework
(Decision 4/CP.13)	Decision on the development and transfer of technologies under the Subsidiary Body for Implementation
Poznan Conference (Decision 2/CP.14)	Adopted the Poznan strategic programme on technology transfer

¹ Article 4, paragraphs 1(c): All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall: (c) 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 gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors.

² Article 4, paragraphs 5: The developed country Parties and other developed Parties included in Annex II 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. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

2.3.3 LITERATURE ON INTERNATIONAL ECONOMIC LAW INSTRUMENTS

Climate Change and international trade, investment and technology transfer issues have intersected in diverse institutional contexts and at several levels of governmental activities. In this regard, the Stern Review (2006) describes the complex relationship between the WTO regimes and climate technology transfer in its recommendation to foster the transfer of climate technology transfer.

International economic law instruments, such as the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) are also directly engaged in technology transfer issues. Article 66.2 of the Agreement specifically concerns itself with the obligations of industrialized countries to facilitate and promote technology transfer to least developed countries. Even if this article represents a positive obligation for the governments of developed countries, the nature of technology transfer covered by this provision is not specified or narrowed down and considerable discretion in designing the different measures is given to member states (Abbott 2003). Recent studies show that the mechanism instituted by Article 66.2 has so far not resulted in all the expected outcomes: many OECD countries have never submitted reports and the majority of the national policies examined do not specifically target least-developed countries or technology transfer issues (Moon 2008).

A central aspect of the TRIPS Agreement is that it not only establishes minimum standards of IP protection, but also incorporates certain flexibility, allowing countries to position IP rights in the context of their public policy objectives and priorities. For example, the TRIPS Agreement allows for certain limitations and exceptions to the protection of IP rights and for national determination of the appropriate method of implementation. These provisions are known as “TRIPS flexibilities” and have been found to provide critical policy space in areas ranging from biodiversity and agriculture to public health and education (Correa 2007). In this regard, Article 7 requires that the international regime of IPR protection “should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare.”

The issue of TRIPS flexibilities was considered during discussions at the UNFCCC, where some Parties expressed their concern that these flexibilities may be insufficient to ensure a rapid and widespread transfer of technology. Reviewing the possibilities for facilitating transfer of climate technology, Correa (2007) concluded that the room available within the TRIPS Agreement to foster technology transfer to developing nations is quite small. The World Bank (2007) also reported that only the elimination of tariff and non-tariff barriers could lead to an increase in the volume of clean technologies exchanged, from 7% if tariffs were removed to 14% following removal of both tariffs and non-tariff barriers, with

particular results in the fields of clean coal, wind power, solar energy, and energy-efficient lighting.

The contribution of existing TRIPS flexibilities to climate-related technology transfer could be significant if access to, and diffusion of, technological innovations in the WTO should be seen from a more general perspective not limited to the field of trade (Cottier 2008), and several provisions of the WTO TRIPS Agreement could be used to promote such transfer of technology. In this regard, scholars, UNFCCC Parties, and other stakeholders are of the view that additional measures should be taken to ensure that the WTO TRIPS Agreement supports the climate regime including the transfer of technology. However, the literature examines areas of conflict that the WTO might face – conflicts that might arise in the course of national legislation and international climate talks. For example, Rechsteiner et al. (2009) pointed out the existence of incongruence between the CDM and the TRIPs Agreement, mainly because some of the conditions required for participation in the CDM projects could be interpreted as discriminatory requirements. Some studies also discuss legality of various policy options debated in national legislation or the UNFCCC under the WTO (Barton 2007; Brack et al. 2000; Brewer and Young 2001; Brewer 2003). From a political economy perspective, they argue that the climate regimes including the transfer of climate technologies could provide opportunities for “free riding” on international agreements hence affecting free market competitiveness (Assuncao 2000).

A growing literature on the interactions between WTO regimes and the emerging technology transfer in the context of climate change regime seeks to find potential win-win arrangements and suggest policy space for transfer of climate technologies and limit GHG emissions without sacrificing national competitive advantage of their own industries, and recommend a new code of good WTO practice on greenhouse gas emission controls (Hoerner and Müller 1996; Hufbauer et al. 2009; Kopp and Pizer 2007; Moon 2008; Morgenstern 2007; Morgenstern et al. 2007; Palmer and Tarasofsky 2007; Werksman 1999; Werksman and Santoro 1999; World Bank 2008).

2.4 LITERATURE ON NATIONAL ECONOMIC POLICIES AND TECHNOLOGY TRANSFER

Literature reviewed in this section reveals that theoretical and practical works on climate technology transfer at the national level focuses on the role of technology for economic development and national policy options or strategies for enhancing the transfer of international technology transfer. The section focuses on literature under three categories: (1) Literature on the role of international transfer for boosting national economic development, (2) Literature on the role of government in formulating national policies to

accelerate the transfer of climate technologies, (3) Literature on south-south climate technology transfer.

The review of literature in this section indicates that there is insufficient attention to explaining the implications of rapid technological advancement of developing countries for accelerating the transfer of climate technology transfer. It also indicates there are few empirical studies on the interconnection of decisions made on climate technology transfer at the national level (in particular in developing countries) and decisions made under the international climate policy regime.

2.4.1 LITERATURE ON THE ROLE OF CLIMATE TECHNOLOGY TRANSFER FOR ECONOMIC DEVELOPMENT

There is broad agreement in the literature on international transfer of technology as an important link between the responses to climate change, involving both mitigation measures and adaptation activities; and achieving per-capita income growth and wider forms of socio-economic development in developing countries (Baram 1994; Barnett 1995; Bell 2012; Forsyth 1998; Goldemberg and Monaco 1991; Heaton et al. 2000; MacDonald 1992; Rath and Herbert-Copley 1993; UNEP 2001). However, there are also a few studies that argue technology imports would ultimately have negative effects on employment and replace the development of technologies within domestic industries (Rawski 1975) and some researchers, for example Kooijman-van Dijk (2012), report the limitation of international technology transfer to benefit small-scale enterprises in developing countries. While, whether or not international technology transfer is beneficial to developing countries has been the subject of considerable debate, the general importance of technology and especially innovation as a contributing factor to economic development is undisputed.

This debate has received little attention in recent literature, in particular in the field of climate technology transfer. The argument for this as stated by Bell (2012) is that greater transfer of climate technologies to developing countries would enable them to pursue growth in more environmentally sustainable directions. UNCTAD (2003, 2007) stressed that access to new technologies and the development of related capacities will play a key role in helping all developing countries to develop their productive capacities and sustain economic growth and poverty reduction. Most literature discusses the contribution of international climate technology transfer to development on a sector-by-sector base. For example, the World Bank (2005) details how renewable energy can help diversify a country's energy portfolio and reduce the risk of over-dependence on fossil fuels, risks that fall disproportionately on the poor, and improve the balance of trade and create new economic opportunities.

The domestic production of renewable energy helps create autonomy by reducing income dependence on agriculture and by fostering creation of a local web of economic

activities that are mutually reinforcing (Biswas et al. 2001). This diversification also contributes to the economic and energy security of a nation (Kapadia 2004). Mallett (2009) also reported that solar hot water systems have been shown to be an excellent way of providing hot water in urban and rural developing country contexts. In summary, the economic benefits associated with the international transfer of climate technologies from the perspective of developing countries as recipient countries could be seen from two perspectives.

Firstly, international technology transfer could contribute to the avoidance of future costs through climate change effects. By providing access to technologies not readily available in developing countries, technology transfer can take advantage of unused, low-cost emission reduction opportunities in developing countries. Taking advantage of these opportunities results in a lower total cost of emissions reductions, by allowing substitution from high marginal cost activities in developed countries to low marginal cost opportunities in developing countries. Transfers of climate technologies potentially lower the marginal abatement cost curve of the recipient country, making future emissions possible at lower costs (Keller 2004). There is broad agreement in the literature dealing with this subject that technology transfer make the costs of adaptation smaller than the benefits, and that climate change impacts and the associated need for adaptation will increase the cost of, and potential for, economic development in developing countries (Agrawala and Fankhauser 2008; Biswas et al. 2001; and IPCC 2007).

Secondly, international technology transfer could contribute to the economic development of a developing country by expanding the country's industrial base. The generation of knowledge, its application in the form of technology, and technological change are key factors in achieving industrial development and economic growth (Cantwell 1994 and Mowery et al. 1991) and international technology transfer contributes to this industrial development in the recipient country (Chakrabarti and Chakrabarti 2002; Foley 1992; Maskus 2004; Stern 2007) though advancement of the competitiveness of an existing industry by increasing productivity and the qualitative development of new products, to the diversification of an existing product range, to the capturing of a larger share of the value chain of a certain product, and to the establishment of new industrial sectors (Barnett 1994; Gereffi et al. 2001; Lall 1998; Maskus 2004; UNCTAD 2007) emphasized that the key to sustained economic growth and poverty reduction in developing countries is increased productive capacities, a core part of which relies on technological progress. However, emissions are not reduced through the productive application of technologies but rather through the diffusion of an environmentally benign technology within a country. The overall amount of emissions reduced is a function of the level of the operating effectiveness of a

specific installation of technology and the number of applications relative to emissions from the alternative not-used technology (Kemp 1997).

2.4.2 LITERATURE ON THE ROLE OF NATIONAL POLICIES

The diffusion of climate technologies differs from conventional technology because their diffusion usually requires some policy intervention. There is a consensus in the literature that existing transfer of climate technologies has largely been the result of government efforts (Barnett 1990; Goldemberg 2006; Orshita and Ortolano 2002; Yanjia 2006).

The UNFCCC Expert Group on Technology Transfer's (EGTT's) technology transfer framework includes an "enabling environment component" which focuses on "governmental actions, such as fair trade policies, removal of technical, legal and administrative barriers to technology transfer, sound economic policy, regulatory frameworks and transparency" (UNFCCC 2007).

A number of studies have emphasised that transfer of climate technology transfer requires some sort of policy intervention in markets (Beise et al. 2003; Bergh et al. 2007; Jacob et al. 2005; Jacobsson and Johnson 2000; Kounetas and Tsekouras 2008; Mulder et al. 2003; Lovett et al. 2012). However, this doesn't mean that markets for climate technologies don't exist without government intervention in developing countries. They do exist, but are limited to small niches, as end-consumers lack the financial means to actually acquire renewable energy technologies themselves (Velayudhan 2003). Nevertheless, as the World Bank (2000) reported for the transfer of climate technologies, both the market and the government policy are important.

A report from the World Bank has shed light on the role of communities; "the diffusion of green technology in developing countries depends equally on markets, governments, and communities." (Hettige et al. 1996: 17). The Bank's empirical studies have drawn attention to how communities can be involved in the transfer of climate technologies, and how policies should be designed in this respect. The World Bank report is based on three studies carried out by the Bank (Hartman et al. 1995; Huq and Wheeler 1993; Pargal and Wheeler 1993, 1995) and a review paper summarizing the studies (Hettige et al. 1996). The concept and relevant empirical findings suggest that both leaving technology transfer to the market, and labeling it as a passive diffusion process are insufficient if the dedicated technology transfer of climate technology transfer is a policy goal (Hutchison 2005; Hurst 1990; Mulugetta et al. 2000).

If there are differences in technological capabilities between countries in climate technology, using the market is one way of arranging for transfer mechanisms. If they are to be transferred to places where insufficient absorptive capabilities exist, policy will either

complement market-based technology transfer or support the creation of technological capabilities (Archibugi and Coco 2004).

The regulatory environment coupled with physical infrastructure and internal absorptive capacity in the form of human capital, together with internal research and development investments, is a key for effectiveness of international climate transfer. In stressing this, UNCTAD (2007) argued that, unless developing countries as recipients in the international technology transfer equation adopt policies to stimulate technological catch-up with the rest of the world, the international effort in promoting climate technology transfer would be unproductive and developing countries will continue to fall behind other countries technologically and face deepening marginalization in the global economy.

A common theme in the literature concerns which policy options or strategies by governments and other agents can accelerate the transfer of climate technologies (Nakićenović and Victor 1993). Other researchers outline ways to harness private-sector activities for technology transfer in order to boost a national low carbon climate resilient economy (Baram 1994; Jaffe et al. 2002).

Perspectives on policy actions that could be used to support technology transfer processes depend on the theoretical perspective chosen. Neo-classical theories recommend an increase of free trade and reduction of state intervention, reduction of distorting factor prices, and the support of functioning markets; whereas evolutionary approaches favor policies to support the learning process of firms (Lall 1992; Fu 2009).

Much of the literature on national policies and approaches for international climate technology transfer investigates appropriateness of the technology that is being transferred. Externalities, for example through spillovers to the local industry to which the technology has been transferred, or other industries or even the economy as a whole, are very important in this respect. There are, for example, technical (referring to the technical risks, operational test data and risk aversion), regulatory (specific restrictions on technology, development and procurement lead times, intellectual property rights, lack of funding) and people barriers (lack of trust, lack of communication, experience with transfer, unawareness of new technologies, lack of information) (Greiner and Franza 2003).

The Marrakech Accords therefore call for technology needs assessments (TNAs). The Accords, which were adopted at COP 7 in Marrakech, in December 2001, fully embrace the idea that the needs and strengths of each nation are different and thus the transfer of technologies requires an approach that recognizes these differences (Boyd and Schipper 2002). Decision 4, among other things, calls for supporting technology needs assessments and enabling environments for technology transfer. The Marrakesh Accords also established

the Expert Group on Technology Transfer and charged it with monitoring the technology needs assessments (Decision 4/CP.7).

Technology needs assessments (TNAs) are a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities particularly of developing countries. Developing country parties have been conducting their TNAs with technical assistance of the UNEP, UNDP and GEF since the Marrakech Accords came into force. The purpose of a TNA is to identify, evaluate, and prioritize technological means for achieving sustainable development in developing countries, increasing resilience to climate change, and avoiding dangerous anthropogenic climate change. This is an attempt to address the concern that, without consideration of development priorities in host countries, there will not be sustainable transfer of technologies or proper use of limited resources.

Technology Action Plans (TAPs) are developed out of the TNA process to establish an enabling framework for specific sectors and technologies; they define the realistic and appropriate set of actions and policies that can help overcome barriers to the deployment and diffusion of prioritized technologies. TNAs can also be seen as a starting point for countries to raise their emission-reduction ambitions, and think about longer-term strategies of adapting to climate change. This means a step change in increasing energy efficiency and the role of renewable technology, radically reducing deforestation, removing fossil fuel subsidies, among other measures.

Article 4.9 of the Convention refers specifically to the specific needs and special situations of the least developed countries (LDCs) concerning funding and transfer of technology. The Marrakesh Accords (COP 7) also established a separate work programme for LDCs. This work programme included the preparation of national adaptation programmes of action (NAPAs) for LDCs to report their prioritized urgent and immediate adaptation needs. In this regard. The rationale for NAPAs rests on the low adaptive capacity of LDCs, which renders them in need of immediate and urgent support to start adapting to current and projected adverse effects of climate change. The Marrakesh Accords launched a Least Developed Country Expert Group (LEG) in order to support LDCs in their preparation and implementation of NAPAs. LEG was mandated to provide technical guidance and advice to LDCs and to facilitate information exchange and promote synergies with other multilateral environmental treaties as well as regional synergies.

2.4.3 LITERATURE ON SOUTH-SOUTH TECHNOLOGY TRANSFER

The evolution of south-south climate technology transfer (SSCTT) is a mostly unnoticed but interesting phenomenon. Emerging economies such as China, India, Brazil, South Africa, Malaysia, Turkey, the Republic of Korea, and some others are asserting themselves as

important sources of 'catch up' innovation with a strong position in specific environmental technological fields.³ China, India, Brazil, South Korea and Russia have become important inventor countries for most climate mitigation technologies, along with the three world leaders: Japan, the USA and Germany. China is a leading country for geothermal and solar sector and is responsible for 8% of the world's inventions and South Korea dominates the market in lighting technology and is the source of more than 6% of the world's investment (Dechezleprêtre et al. 2008). Brazil is considered to have the world's first sustainable biofuels economy and is the world's second largest (just next to USA) producer of ethanol fuel and largest exporter. In 2010, Brazil produced 26.2 billion liters, representing 30.1% of the world's total ethanol used as fuel (Renewable Fuels Association 2011). Thailand exported approximately US\$ 2.3 billion of water treatment, pollution control and renewable energy technologies in 2007, mainly to developing countries such as Ethiopia. The emerging economies have also extended their technical expertise in environmentally sound technologies to several developing countries through trade, Foreign Direct Investment (FDI), human movement and other forms of channels (Baron 1993).

The south-south cooperation (SSC) concept has evolved over the years, gaining as well as losing momentum over time, depending largely on current conditions in the global economy. The embryonic mechanism for SSC received its conceptual and operational framework from the Buenos Aires Plan of Action of 1978, which aimed to further explore 'Technical Co-operation among Developing Countries' (TCDC) activities in specific sectors (UNDP 1995). Today, after decades of consolidation, the discourse of SSC has achieved a certain level of maturity and the minimum financial and human resources required to promote meaningful change. With its growing popularity and the emergence of the BICS (Brazil, India, China and South Africa) economies, SSC has moved to the forefront of many bilateral agreements, UN agencies and international organizations' mandates, and multilateral cooperative initiatives. Development practitioners are envisioning SSC as a policy tool to help in local, regional and national development processes.

2.4.4 LITERATURE ON OVERARCHING THEORIES TO EXAMINE THE RELEVANCE OF SOUTH-SOUTH TECHNOLOGY TRANSFER

Dependency theorists view SSC as a possible source of self-reliance for the South, and an alternative to NSC (Smallman and Brown 2011). They argue that the economic surplus of developing countries (peripherals or satellites) was expropriated, while generating economic development in the developed countries (cores or hegemonic or centers), which appropriate the surplus (Frank 1971). The assumption is that at the core of the dependency relation

³ Based on the analysis of patent data.

between center and periphery lies an inability of the latter to develop an autonomous and dynamic process of technological innovation (Vernengo 2004). As a result, center countries control technology and the systems for generating it, putting technology at center stage.

They argue that technology transfer from developed to developing countries is a mechanism through which the center consolidates its economic and cultural domination over the periphery (Darity and Davis 2005). The dependency school of thought believe that enhancing manufacturing capacity in developing countries is important for eliminating the structural divide between the center and the peripheries (Burbach and Robinson 1999). Through cooperation amongst themselves, developing countries could develop technological capacity and avoid the deteriorating disadvantageous terms of trade, and thereby circumvent the dependency ties that keep them underdeveloped and subordinate (Milios 2007; Smallman and Brown 2011).

Based on these assumptions, the dependency school of thought has been advocating South-South Cooperation (SSC), that is, cooperation between the “peripherals”. The concept of SSC for dependency theorists such as Cardoso and Falleto (2004) and Senghaas (1979) is understood as a mechanism through which countries of the global South (the periphery) would be enabled to overcome dependence from the industrialized nations of the global North (the core). The dependency theory assumes that economic domination runs across north-south geo-economic patterns.

Dependency theorists view North-South technology transfer at the core of the world economic system as harmful to long-term economic growth of developing countries, preventing them from emerging out of the periphery. They argue that technology transfer is just one more area through which the center (the North) consolidates its economic and cultural domination over the periphery (the South) (Darity and Davis 2005). They believe that at the core of the dependency relation between center and periphery lies an inability of the latter to develop an autonomous and dynamic process of technological innovation. As a result, center countries control technology and the systems for generating it (Vernengo 2004). They argue that north-south cooperation, which is marked by significant technology gaps, can't solve both environmental and developmental problems, since the north –south capital flow leads only to limited transmission of technology, not to the process of innovation itself. The solution, as they believe, is cooperation among the peripherals, which is horizontal and composed of equal interactions.

However, some developing countries such as China, India, Russia, South Africa, South Korea, Turkey and Mexico, have emerged as global economic powers, and have come to represent an unusual position within the center-periphery framework. That is, these countries do not fit the theoretically constructed pattern of either a center or a periphery nation,

particularly in their relations with least developed countries, such as Ethiopia, which is the case study in this thesis. In this regard, Immanuel Wallerstein's notion of the 'semi-periphery' could be useful, particularly for analyzing the relationship between countries of the global South with different technological advancement.

Technologically more advanced developing countries exhibit semi-peripheral characteristics. The idea of the semi-periphery is derived from the world system theory postulated by Wallerstein, which itself is a derivative of the dependency theory. The world system theory moves away from the stark bifurcation suggested in the dependency theory, which merely distinguishes between the core and the periphery. Middle-income countries perform a certain function in relation to the core and the periphery; they act as a buffer zone between these two extremes (Wallerstein 1979).

Semi-peripheral theorists believe that economically, semi-peripheral countries are intermediate, because the more powerful countries exploit them; at the same time they exploit weaker peripheral countries (Graaff and Venter 2001). Indeed, it becomes more evident that the semi-periphery has a particularly complicated role within the world system. As an improvement from dependency theory, the semi-periphery allows world system theorists to escape stagnation (Graaff and Venter 2001), which confined the dependency school, but also to make sense of the dramatic economic development of middle-income developing countries.

However, both world system and semi-peripheral theories, as part of dependency theory, have addressed SSC viewing it as a possible way out of the exploitative economic relations with the North and as a possible source of self-reliance for the South (Haq 1980). On the other hand, the realist school of thought views SSC as a political strategy employed by regional powers (i.e. BICS: Brazil, India, China, and South-Africa,) to have weaker states such as Ethiopia under their control, thereby elevating their influence in the international arena (Schweller 1997). Realist scholars have conceived states as homogenous actors in an endless process of power struggle for survival and domination. Consequently, from the realist perspective, real cooperation among states is unlikely and SSC is a strategy used by dominant emerging south states to secure power (Mundy 2007). The realist school of thought argues that SSC, is therefore promoted by regional hegemonic powers (BICS) to consolidate their dominance and influence, and it would be effective as long as it doesn't diminish their power (Karns and Mingst 2004; Woods 2001). The Mercantilists share the realist presumptions in SSC and describe the world economy as an arena for inter-state competition for power, where states seek to maximize their wealth vis-à-vis other states (Woods 2001). They argue that the new powers from the South, in particular BICS, are engaged with LDCs in a SSC framework in order to meet their cheap production and natural resources demand,

and then use LDCs as a market for their manufactured goods (Kreitlow 2007). They view the stronger presence of emerging economies like China and India in less developed southern countries as a “monolithic dragon scrambling for natural resources to service their own growing capitalist economy” (Mohan and Power 2008 p. 25). They further state that the BICS export strategy is contributing to de-industrialization of LDCs (Mbeki 2006).

2.4.5 LITERATURE ON ETHIOPIA CLIMATE CHANGE POLICIES AND STRATEGIES

Ethiopia conducted a Technological Needs Assessment (TNA) in 2008 and submitted its First National Communication in 2001 and a National Adaptation Program of Action (NAPA) to UNFCCC in 2007. The country has completed preparation of a new work program for action, the ‘Ethiopian Program of Adaptation to Climate Change’ (EPACC), that updated the 2007 NAPA, and has also developed an overarching framework and national strategy, the “Climate Resilient Green Economy” (CRGE).

According to the Initial National Communication of Ethiopia to the UNFCCC, GHG emissions in Ethiopia totaled 48,003 Gg CO₂-equivalents in 1994, excluding CO₂ emissions/removals in the land use and forestry sector. Sector-wise, Ethiopia’s GHG emission profile is dominated by emissions from Agriculture contributing 80% of the total while gas-wise it is dominated by CH₄ contributing 80% of the total CO₂-equivalent emissions in 1994.

The Technological Needs Assessment (TNA) of Ethiopia was based on the IPCC greenhouse gas emission categories/sectors namely; energy, agriculture, land use change, and forestry, industrial processes and waste. Sub-sectors were also selected under each sector based on the relative magnitude of GHG emission levels.

The Ethiopia TNA identified and prioritized technologies for GHG reduction in the five sectors as follows: (1) Priority technologies for the energy sector include, micro-pico hydropower generation, photovoltaic, geothermal, wind turbine, alternative fuel, compact and efficient vehicles etc. (2) Priority technologies for the agriculture sector include technologies for reducing emission of methane from grazing livestock and technologies for reducing N₂O (3) Priority technologies for land use change and the forestry sector include improved management of existing forests, expansion of forest cover and sustainable use of wood fuels as a substitute for fossil fuels (4) Priority technologies for the industrial process sector include raw material conservation, efficient use of end products, material recycling, and technology improvement (5) Priority technologies for the waste sector include composting, sanitary landfill and integrated solid waste management.

A number of barriers for technology transfer were identified in each sector. The most common barriers cited in all sectors of the Ethiopia NPA were lack of: financial resources,

technical capacity, awareness, adequate coordination, institutional set up and clear policies/mandates.

The quality of the Ethiopia TNA could be questioned simply by looking at the absence of quality review in the UNFCCC TNA process and lack of genuine and legitimate stakeholder consultations in the TNA preparation. The Ethiopia TNA also acknowledges that the report was not exhaustive, and suggested further studies and assessments to create a clear picture of the technological needs of the country. Critical assessment is not possible as there are no literature on the TNA, or comment of experts and scholars.

The lack of academic literature is not only just on the Ethiopia TNA, but also in general there are no studies on the quality of Ethiopia climate change related policies, strategies, regulations and reports. There is some literature on technology transfer in the Ethiopian agriculture sector. Aberra and Beyene (1997) mention that the major technology transfer problem in the Ethiopian agriculture sector is lack of efficient dissemination pathways. Mulugeta (1998) found that annual productivity of crops in Northern Ethiopia was declining, partly owing to the lack of appropriate extension of available technologies. Technology transfer and adoption studies in eastern parts of Ethiopia have also identified that full participation of farmers was not considered as the basic strategy in technology dissemination (Wegayehu 1997; Gebre-Michael et al. 2009).

The aim of technology assessment is to: inform decision makers, provide an early warning signal for unintended consequences, prepare stakeholders for possible technological changes, or facilitate the participation of stakeholders in decision-making (Smits and Leyten 1988). Therefore, stakeholder participation and feedback loops should be emphasized. The process of performing the TNA involves formation of a network of stakeholders who are involved in energy, climate change planning, and adaptation activities; as well as consulting technology owners and practitioners, entrepreneurs, communities, and sector representatives. Stakeholder perspectives can lead to development of a shared vision for moving forward. The key role of stakeholders for implementing change has been recognized in many studies (IPCC 2000; Morsink et al. 2011; Lovett et al. 2012; Lundvall et al. 2002), which indicate that new ways of operating can emerge from exploratory activities combined with deliberative processes.

The Ethiopia National Adaptation Program (NAPA) presented international technology transfer as one of the major vehicles to implement effectively the projects identified in the report. The NAPA has identified twenty project ideas that address immediate climate change adaptation needs of the country. These projects broadly focus in the areas of human and institutional capacity building, improving natural resource management, enhancing irrigation

agriculture and water harvesting, strengthening early warning systems and awareness raising.

Ethiopia's Climate- Resilient Green Economy (CRGE, 2011), a relatively recent document, has three complementary objectives: fostering economic development and growth, ensuring mitigation of greenhouse gases (GHGs), and supporting adaptation to climate change. This vision asserts that building resilience to avoid damage to the economy depends on understanding the threats and priority areas for focusing adaptation efforts. The document sets out the challenges and opportunities which climate change brings for Ethiopia. It makes the case for why a carbon neutral and climate resilient development trajectory to a green economy is a priority for the country, and thus for the implementation of the country growth and transformation plan.

The Green Economy Strategy identified seven sectors that offer the highest greenhouse gas abatement potential: power supply; buildings and green cities; forestry (REDD+); agricultural/soil-based emissions; livestock; transport; and Industry. In general four initiatives for fast-track implementation have been selected under the CRGE: (i) exploiting Ethiopia's vast hydropower potential; (ii) large-scale promotion of advanced rural cooking technologies; (iii) efficiency improvements to the livestock value chain; and (iv) Reduced Emissions from Deforestation and Forest Degradation (REDD). The CRGE was made public in 2011 during the COP 17 Durban climate conference and investment of about \$150 billion was estimated for its implementation up to 2030.

2.5 LITERATURE ON FIRM LEVEL TECHNOLOGY TRANSFER

The review of literature in this section is on climate technology transfer at the firm level and focuses on analyzing case studies specifically on mechanisms for technology transfer and investigating how specific mechanisms contribute to the technological learning of recipient firms in developing countries. There is, for example, extensive research on foreign direct investment, joint ventures, licensing and research and development (Hobday and Rush 2007; Ivarson and Alvstam 2005; Kuemmerle 1999; Mowery and Oxely 1995; Pack and Saggi 2001).

The section shows that literature on firm-level support for technology transfer is inadequate for understanding the big picture of climate technology transfer. This research emphasizes giving a broader picture of climate technology transfer through empirical evidence from a smaller-scale unit: firm level technology transfer. The section also describes the paucity of empirical studies that take into account the perspective of actors involved in actual climate technology transfer activities. It indicates that a limited amount of research has

been undertaken on the impact of political and institutional factors for effective firm level technology transfer.

2.5.1 LITERATURE ON THE MOTIVATION OF FIRMS FOR INTERNATIONAL TECHNOLOGY TRANSFER

Firms have a variety of motives for international technology transfer, although their main goal remains, in most cases, maximization of financial gains and building competitive advantages that enable them to make profit and to stay ahead of competitors (Narula and Dunning 2000). This generalized motive applies to both technology suppliers (in most cases multi-national companies) and recipient country firms. However, these two technology transfer actors could have some differences when it comes to details of their motives. A number of empirical studies support this assumption by revealing that different expectations exist between supplier and recipient regarding goals, as well as the content, of the international technology transfer processes (Bennett et al. 1997).

For example, supplier firms participate in international technology transfer in order to increase market share, lower production cost, restructure existing production through rationalization, seek strategically related created assets, diversify product outreach, gain strategic advantages over competitors, and gain knowledge about local markets (Goulet 1989; Narula and Dunning 2000); or according to Gilpin (1987), to enter into protected markets and for long term strategies (Kooijman-van Dijk 2012). Bruun and Bennett (2002) put it in more economic terms: firms transfer technology abroad in order to take advantage of cost and market factors, or as Gassmann (2003) argued, the purely monetary return of such transfers in the form of licensing fees. While technology supply firms have a number of incentives to transfer parts of their technology internationally, at the same time they also have an interest in controlling their technological assets. The interest in control over technology stems from the importance of technological advantage for the economic performance of the business firm (Gassmann 2003).

Suppliers critically select recipients and countries, and engage in international technology transfer management to retain some parts of their specific knowledge, despite all inherent interest in the success of the transfer process (Cannice et al. 2003; Liebeskind 1996). This transfer management includes transferring outdated technology, retaining core technology, increasing research and development efforts, changing ownership structures of subsidiary firms, accepting leakage and attempting to keep personnel (Bruun and Bennett 2002; Cannice et al. 2003).

As with technology recipients, cost minimization using foreign technologies is a strong motivation. But other motivations may be quite different from those of supplier firms, such as: (a) technical capabilities, quality, or cost reductions, that they cannot achieve on their own

(Archibugi and Coco 2004; Kogut and Zander 1993); (b) enhancing their reputation through the higher perceived status of “international level” technologies (Welsh et al. 2008); (c) access to managerial and marketing expertise, (d) access to export markets; and (e) access to distribution networks or other organizational assets (Samli 1985). Recipient-country firms may also seek energy-efficiency and renewable-energy technologies to comply with domestic environmental regulations.

2.5.2 LITERATURE ON MEASURING THE EFFECTIVENESS OF TECHNOLOGY TRANSFER

There are different approaches, methods, and indicators in the literature regarding measuring technology transfer at the firm level, but there is agreement that measuring technology transfer is inherently difficult because technology has no measurable physical presence or a well-defined price (IPCC 2000; World Bank 2008). Patent counts are frequently used as a proxy for technology output (Archibugi and Pianta 1996; Branstetter 2001; Eaton and Kortum 1996; Jaffe and Trajtenberg 1996). However, some researchers have serious concerns in using patent count as indicator for measuring technology transfer. Keller (2004) argued that patent statistics did not report transfers related to non-codified technology, and that patent count misses technologies that are not patented, particularly in developing countries where a large set of innovations are not patented. Also, if technology is in part non-codifiable, patent statistics miss that part (Keller 2004). Some researchers have pointed out that foreign R&D and exposure to trade could measure technology transfer through regression analysis where productivity is jointly explained (Bayoumi et al. 1999; Basant and Brian 1996; Hoekman and Javorcik 2006; and Xu and Wang 1999).

Other studies, however, consider that import shares are not necessary for measuring the extent of technology transfer, as transfers do not necessarily occur through trade (Keller 1999; Hutchison 2005). Bell (1989) developed a model to show the possible contribution of international technology transfer of industrial technology to the technological capabilities of the recipient. He distinguishes three different types of technology flow from technology supplier to technology recipient, each with different qualities: (1) Flow A comprises the capital goods and services needed to create the physical facilities of a new production system; (2) Flow B refers to the skills and know-how needed to operate and maintain the newly installed production facility; (3) Flow C refers to the skills and knowledge necessary to generate technical change. In practice, however, there are difficulties in precisely applying Bell’s model for measuring technology transfer.

2.5.3 LITERATURE ON OVERARCHING THEORIES TO EXAMINE THE EFFECTIVENESS OF TECHNOLOGY

TRANSFER

The Actor Network Theory (ANT): When technologies are transferred within and among actor-networks, they make sense in different ways depending on the way they are translated by the actors, and the way they used to sustain or challenge the network. From an ANT point of view, successful technology transfer processes are a matter of creating, maintaining and strengthening heterogeneous networks so that they create durable connections. So in order to understand how a project progresses (or fails to progress) we need to “follow the actor” and observe how they extend (or fail to extend) the actor networks in which they are involved (Garrety et al. 2001).

The basic elements of the theory are the existence of human and non-human actors and how they are tied together into networks, which are built and maintained to achieve a particular goal (alignment) (Bijker and Law 1992). Networks are constructed out of human actors (people, organizations, groups of scientists, engineers, companies, etc.) and non-human actors (documents, competences, money, technological objects, machines, rules, software, etc.) (Akroyd 2001). ANT developed dynamic and flexible views as socio-technological approach to technology transfer by mixing technological, economic and human factors to explain how technology is transferred.

In ANT it is recognized that technologies do not evolve under the impetus of scientific logic and they are not possessed of an inherent momentum that allows passing through a neutral social medium (Latour 1999). In effect, “our technologies mirror our societies” (Bijker and Law 1992) as they are continuously shaped and reshaped by the interplay of a range of heterogeneous forces within the networks.

What actor-network theorists seek to investigate are the means by which associations come into existence and how the roles and functions of subjects and objects, actors and intermediaries, humans and non-humans are attributed and stabilized (Murdoch 2001). Translation builds actor-networks from entities and it attaches characteristics to them and establishes more or less stable relationships between them (Murdoch 2001).

The Theory of Absorptive Capacity (TAC): The role of absorptive capacity in receiving organizations has been identified to be one of the most important determinants in technology transfer (Yoeh 2009). Absorptive capacity addresses a highly relevant aspect of organizational activities by focusing upon a firms’ ability to sense their information environment, to recognize new technological opportunities and to capture and integrate new information and knowledge into the firms’ processes and routines with the subsequent aim and result of increased competitive advantage (Lane and Lubatkin 1998). The term

absorptive capacity was introduced by Cohen and Levinthal (1994) to describe the requisite capabilities of a firm to innovate. They define absorptive capacity as a firm's ability to recognize the value of new, external knowledge, assimilate it, and apply it to commercial ends. The premise of the notion of absorptive capacity is that the organization needs prior related knowledge to assimilate and use new knowledge (Kim 1991). The potential to learn is greatest if the new knowledge that needs to be assimilated is closely related to the prior knowledge base (Lane and Lubatkin 1998).

Zahra and George (2002) further explain it as a kind of accumulation and flow of organizational knowledge. They extended the theory by defining it as the process of knowledge acquisition, assimilation, transformation, and exploitation. Vincent Chauvet (2009) detailed the dimensions of absorptive capacity as: (a) recognizing and valuing new external knowledge (Acquisition), (b) a firm's routines and processes that allow it to analyze, process, interpret and understand the knowledge obtained from external sources (Assimilation), (c) the internalization of new external information (Transformation), and (d) applying new learned external knowledge to commercial ends (Exploitation).

In empirical work, absorptive capacity is usually analyzed in quantitative terms and is measured via critical factors of absorptive capacity such as: (1) technology diffusion channels and interaction mechanisms (Lin et al. 2002), (2) emphasizing employees' ability and employees' motivation (Minbaeva et al. 2003), (3) communication, and (4) diversity and strategic positioning (Nieto and Quevedo 2005).

2.6 KNOWLEDGE GAPS AND VALUE OF THE STUDY

This research differs in four major ways from preceding work. First and foremost, it emphasizes interconnections of the multi-level structures of climate technology transfer (decisions made at the three levels: international, national, and firm levels.). The literature review presented above on international climate technology transfer revealed that what we know about international technology transfer is fragmented between the three levels: research on firm level climate technology transfer, research on national technology transfer and research on international climate policy debates. Under the divided perceptions of between north and south, countries have been negotiating arrangements for technology transfer in international climate agreements, national governments have been preparing policy documents mainly as a response to international requirements and transfer of technology has been taking place at the firm level. All these have been happening without sufficient empirical evidence at the multi-level and multi-scale transfer of technology. Thus, filling the knowledge gap with actual cases may facilitate the difficult negotiations, improve the quality of climate policies, and accelerate the transfer of climate technologies.

Second, this research emphasizes the dynamic aspects of international technology transfer, rather than the static aspects such as measures and modes of transfer. The thesis investigates the reasons for the difficulties in developing a concrete international policy on climate technology transfer. It also examines the asymmetry in parties' interests and demands on international climate technology transfer under the UNFCCC and its implications for international climate governance, national policies and technology transfer at the local level. Much prior work on international technology transfer concentrated on analyzing specific measures and modes of technology transfer, reviewing principles and objectives of international technology, suggesting policy space for transfer of climate technologies, compiling and synthesizing case studies and evaluating projects. There is no detailed analysis of country positions under the UNFCCC in the academic literature.

Third, the level of innovation across countries has changed rapidly in recent years and the direction of international climate technologies has shown changes accordingly. Some developing countries are exporting climate technologies; and transfer of technologies from South to South and from South to North have been already observed. The role of government in enhancing technology transfer is becoming more heterogeneous across countries and is getting more complex. This research recognizes these realities and new paradigms, and analyzes their implications for accelerating the transfer of climate technologies. Despite the wide recognition of economic advancement and technological sophistication of developing countries, these changes in relation to international technology flow have not received sufficient attention in academic research, and no coherent international policies under the UNFCCC have yet been formulated. Much of the theoretical and practical work relating to the transfer of climate technology at the national level has emphasized international transfer of technology as an important link between the responses to climate change, and achieving national economic development including appropriateness of technologies and national policies for technology transfer.

Fourth, this research emphasizes the broader picture of climate technology transfer through presenting empirical evidence from a smaller-scale unit: firm level technology transfer. The thesis takes into account the perspective of actors involved in actual climate technology transfer activities, reviews the characteristics of technology transfer networks and analyzes the quality of firms network relationships. It looks at how the political and institutional contexts influence firm level technology transfer.

Prior work on climate technology transfer usually does not take into account the perspective of actors involved in actual climate technology transfer activities. The literature review in this chapter shows that studies on international technology transfer focus on specific mechanisms for technology transfer, and measures of transfer do not take into

account the diversity of channels through which these happen, and the outputs and effects that they convey. Choosing one specific mechanism, and related theories on how such a mechanism supports technology transfer, is inadequate for understanding the overall picture of climate technology transfer. In addition, although the technology transfer literature is extensive in terms of understanding institutional contexts, it is weak in terms of understanding political influences on transfer of technologies.

This dissertation aims to fill gaps in knowledge associated with these four areas of climate technology transfer. The study also serves as a starting point for future research and contributes to the climate technology transfer debate by presenting empirical evidence and analytical analysis of international climate policy, national development approaches in the context of climate technology transfer, and local transfer practices. The strength of this study stems from its perspective and approach in examining the level of interconnections between the different scales of climate technology transfer. Perhaps the most valuable aspect of this study is its potential to build on the comprehensive and broader notion of climate technology transfer by providing information on the synergies of decision-making structures that result from analytical analysis of socio-political and technical factors at different scales, and how the different entities intervene and influence the decision making processes.

CHAPTER 3 METHODOLOGY

The previous chapter reviewed the theoretical and empirical literature relevant to this doctoral research and the identified gaps in knowledge. This chapter presents the research design and methodology to answer the research questions. The chapter starts by describing the general research approaches and methods that were applied, as well as the rationale for the chosen research methods. This is followed by explanations of the instruments used and the processes followed for data collection and analysis.

3.1 RESEARCH METHOD AND DESIGN

This thesis examines the relationships between multi-leveled decision structures for climate technology transfer through an exploratory assessment of top down macro-policy analysis, and bottom up micro-implementation analysis. Specifically, the research addresses the research question: *what is the relationship between firm practices, national policies, and international discourses for climate technology transfer and if there is a disjunction, then why?* The overall focus of this thesis lies in better understanding the interconnections and synergies between the different scales to fill the knowledge gaps identified in Chapter 2 with empirical evidence. The thesis explains the value of international climate technology transfer by investigating micro-level processes in the form of national experiences and firm level transfer practices in the context of international climate policies to gain empirical data. At the same time, the thesis looks at the complexity and challenges of trying to achieve micro-level technological change for environmentally friendly development in developing countries through a decidedly macro-level policy process. The thesis combines top-down macro-policy analysis with bottom-up micro-implementation analysis and undertakes primary research on all three levels to obtain evidence on whether, and how, the three levels interact. It also seeks to gain detailed understanding of international technology transfer under the UNFCCC, an in depth understanding of national approach to international climate technology, and an analysis of its practical implementation at the local level.

Firstly, technology transfer in the context of international climate change negotiations is examined to explain the causes for the lack of ambitious international climate technology transfer agreements. The major research question, therefore, to be answered by this component is “Why did countries fail to reach ambitious climate technology transfer agreements?” While addressing this question the section (Chapter 4) also looks at the

asymmetry in parties' interests and demands on international climate technology transfer under the UNFCCC.

Secondly, the realities in south-south climate technology transfer are investigated by answering the research question: What is the nature of collaboration between developing countries for promoting climate technology transfer at the national level vis-à-vis North-South technology transfer? This component specifically investigates the potential, motivational factors and the characteristics of South-South technology transfer compared to North-South technology transfer.

Limitation in existing literature on providing details about the broader picture of climate technology transfer through empirical evidence from smaller-scale units, and the limitations of studies looking at the perspective of actors involved in actual climate technology transfer activities is addressed in the third component. This stage of the research studies implementation of national policies at the local level in the context of international negotiations. Here, effectiveness of international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing the transfer of climate technologies at the firm level is evaluated by taking into account the perspective of actors involved in actual climate technology transfer activities. This section reviews the characteristics of technology transfer networks and analyzes the quality of firms' network relationships. The research question for this component is: "How effective are the international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing transfer of climate technologies at the firm level?" Table 3.1 presents the operationalization of these research questions.

Climate technology transfer is a highly complex process that evolves over time with no clear temporal boundaries. Qualitative research methodology helps in understanding how this complex, multi-leveled techno-social world is interpreted, investigated, and evaluated (Mason 1996). Qualitative research methodology is more appropriate for this research project inquiry because it requires data collection and interpretation that is flexible and sensitive to the social and political context (Mason 1996). In addition, because of its complexity, understanding of climate technology transfer requires a holistic approach. Qualitative research methods can provide such a comprehensive view. However, as Patton (2002) points out, one of the problems associated with this methodology is the potential subjectivity and bias in data collection and analysis. In order to tackle this potential problem the perspectives of interviewees and survey respondents from a wide variety of backgrounds, and with diverse affiliations, was triangulated.

TABLE 3.1 RESEARCH QUESTIONS AND METHODS FOR EACH STAGE OF THE RESEARCH

Overarching research question: what is the relationship between firm practices, national policies, and international discourses for climate technology transfer and if there is a disjunction, then why?

Research Stage	Specific Research Questions	Method
1 st Stage: International climate policy debates	What were the preferences of developing and developed countries for promoting and implementing climate technology transfer? What was the origin and structure of countries' incompatible preferences and bargains? How was the quality of the Copenhagen Conference outcome affected by the incompatible preferences and bargains of the parties?	Observation of international climate change conferences, interviews of participants and delegates at a climate change conferences (mainly in Bonn), interpretation of treaties and historical secondary sources
2nd Stage: National approaches for climate technology transfer	What is the potential of South-South cooperation for climate technology transfer compared to North-South technology transfer? What are the motivational factors for the transfer of climate technology from one developing country to another? What are the characteristics of South-South technology transfer compared to North-South technology transfer?	Survey to collect the perspectives of experts, researchers, policy makers, and practitioners on the government of Ethiopia low carbon climate resilient development approaches and international technology cooperation. The survey is administered through questionnaires backed by follow up interviews and focus groups discussions with professionals and policy makers in Addis Ababa. Content analysis of newspapers, news briefings, policy documents, archives.
3rd Stage: Local relationships and firm level practices	How are network relationships characterized, how are networks tied up and stabilized in SSCTT, NSCTT and NSSCTT? How is absorptive capacity and technological learning characterized in SSCTT, NSCTT and NSSCTT? What are the challenges and benefits of the three modalities of cooperation for enhancing effective climate technology transfer, how could the challenges be overcome?	A case study to gather and analyze relevant data. The empirical material includes direct observational evidence of actors, institutional context, and processes, interviews (formal and informal), reviewing relevant published material and the study of documentation available in the various international and local organizations involved.

Balnaves and Caputi (2001) and McCracken (1988) point out that quantitative methodology allows the researcher to gain a sharp focus on a limited set of predetermined research categories. However, climate technology transfer data for the purposes of this research do not exist as such, and only some imperfect proxies can be used to provide an idea of the extent of these transfers. Quantitative studies that define and measure technology transfer, and explain the factors that drive and enable them, are therefore limited by lack of data. Nevertheless, case studies, observation, and survey research methods complement the qualitative studies by generating in-depth and broader descriptions of climate technology transfer, whilst at the same time showing the actual technology transfer process in its context and by providing a focused, localized, empirical, and qualitative approach to understand the variables that govern successful technology transfer.

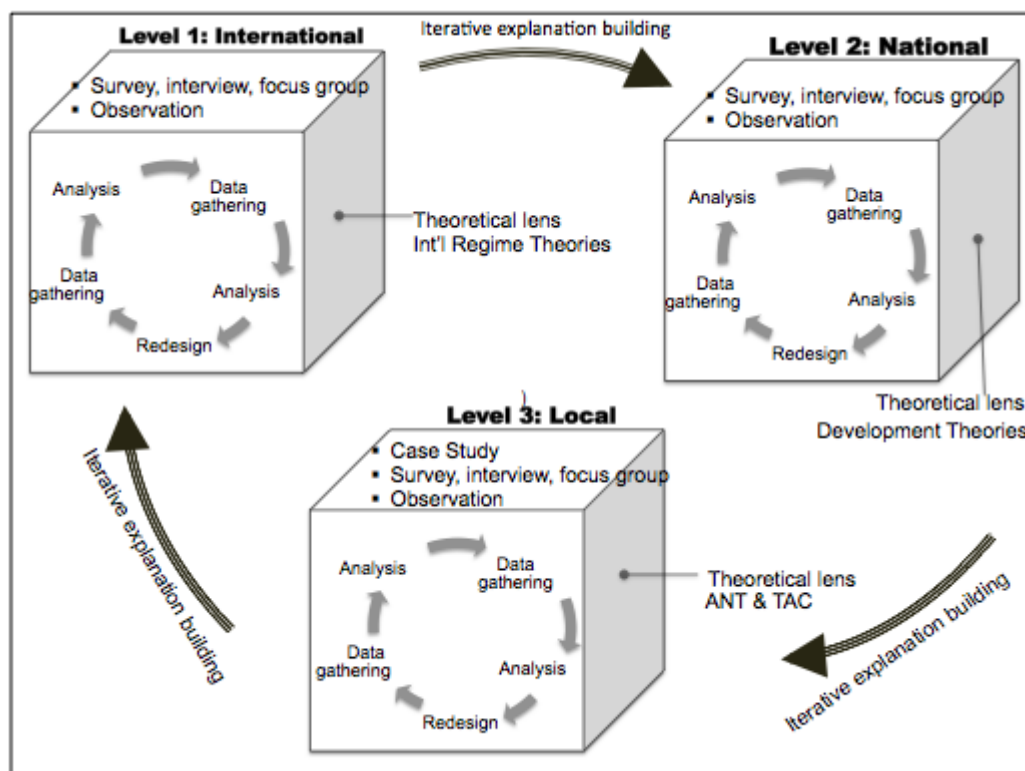
This research, as shown in Table 3.1, employs a combination of case study, survey, and observation research methods. The combination of these methods enables the explanatory qualitative research to use first-hand experience and quotations of actual conversations to reach an understanding of climate technology transfer and provide an explicit rendering of the structure, order, and broad patterns found at each of the three levels investigated.

Qualitative researchers have frequently suggested that research design, data collection and analysis are simultaneous and continuous processes (Burgess 1984; Goetz and LeCompte 1984). This is the guiding principle of the research methodology of this thesis as demonstrated in the methodological framework diagram (Figure 3.1). In the framework of this guiding principle, this research follows the constant comparison method as an overall analytic strategy to interpret and analyze data. According to Goetz and LeCompte (1984), this method includes a simultaneous comparison of all social incidents observed. As social phenomena are recorded and classified, they are also compared across categories. Thus, relationship discovery begins with the analysis of initial observations. This process undergoes continuous refinement throughout the data collection and analysis process. As events are constantly compared with previous events, new topological dimensions, as well as new relationships, may be discovered (Geels 2007, 2009; and Goetz and LeCompte 1984).

To trace the relationships between the international (Chapter 4), national (Chapter 5) and the firm level (Chapter 6) climate technology discussion structures and ensure the continuous refinement of the data collection and analysis process, this research employs an “iterative explanation building” and “concurrent analysis technique”. “Iterative explanation building” is a technique, which aims at iterative explanations of the object of study to trace causal links (Yin 2003).

In order to trace relations between the three levels of analysis (international, national, and firm levels), each research chapter (Chapter 4, 5 and 6) relates findings to the other levels of analysis. Linking of the three levels of analysis was done to trace possible causal links and to support the holistic picture of climate technology transfer. Application of the iterative explanation building analysis technique enables the research to combine the top down macro-policy analysis and bottom up micro-implementation analysis (Geels 2002 and 2006). The analysis in each level takes place concurrently with data collection. This early and continual analysis approach enables the collection of better data by cycling through old and new data, and adjusting tactics and even strategies based on what Bogdan and Biklen (1982) distinguished as preliminary findings.

FIGURE 3.1 THE METHODOLOGICAL APPROACH OF THE THESIS



As indicated in Figure 3.1, data analysis is an ongoing iterative process where data was continuously collected and analyzed almost simultaneously. This causes the researcher to move backwards and forwards between different sequences in the research process. This echoes the view of Wiseman (1974) when she writes that the “constant interplay of data gathering and analysis is at the heart of qualitative research”.

In each level, data collection and analysis happened concurrently: new analytic steps informing the process of additional data collection and new data informing the analytic

processes. Because of this social science researchers such as Shamoo and Resnik (2003), and Green et al. (2007) underscore the fact that qualitative data analysis process is not entirely distinguishable from the actual data collection.

The methodological diagram (Figure 3.1) demonstrates this, and to put this in context, in this research, data collection methods were redesigned and future interview questions were modified, based on analysis results of completed surveys and interviews. This kind of approach is important to social research as qualitative research seldom involves the use of a straightforward set of procedures (Miles and Huberman 1984), but instead research design, data collection and analysis is interwoven (De Vaus 1991). It is also well summarized by Bechhofer (1974) when he stated: “The research process, then, is not a clear cut sequence of procedures following a neat pattern, but a messy interaction between the conceptual and empirical world, deduction and induction occurring at the same time”.

When the concurrency approach was impractical due to the busy schedules during the interview process and participant availability was limited, survey results and prior interview transcripts were read, and notes were made, to enable the conduct of the next interview to be better focused. Probes were fashioned and tactics refined and the interview process evolved as it progressed through the research participants. The aim was to constantly engage in preliminary analytic strategies during data collection (Bogdan and Biklen 1982).

As indicated in Figure 3.1, this thesis uses different theoretical lenses to analyze the relationships of the three decision-making levels of international climate technology transfer. For further information on use of theories in this research as a conceptual and methodological tool please see Section 3.2.4.

3.2 DATA ACQUISITION AND INTERPRETATION

The major data collection methods used in this thesis are interview, questionnaire, observation, and case study, as the research problem requires multiple methods (Brewer and Hunter 1989). A conventional multi-method approach generates multiple data sets from analysis of the same problem, which can then be cross-validated (Baker 1994), enabling a more valid and reliable construction of realities. Details of the practical data gathering are explained in each of the research chapters (Chapter 4, 5, and 6). In this section the three major data collection methods, (survey, observation, and case study) of the research are presented in a generic sense. However, a relatively more in depth discussion is given to qualitative semi-structured and unstructured interviewing since it was identified as the most suitable method for collecting data and is the most frequently used technique in all the three research chapters.

The qualitative survey data collection methods used in this research comprises both open and closed ended questions intended to measure participants' general perceptions and attitudes about countries' positions on international technology transfer discussions under the UNFCCC, national technology cooperation approaches and firm's technology partnership modalities. The survey enables data capture from a wide participant pool, while obtaining the broader view of climate technology transfer. McIntyre (1999) observed that surveys elicit information about attitudes that are otherwise difficult to measure using observational techniques.

However, the survey instrument was generally unsuitable for gathering information relating to the historical context of climate technology transfer such as previous international agreements, national technology transfer policies, regulations, and firm contractual agreements etc. Pinsonneault and Kraemer (1993) noted that surveys are generally unsuitable when an understanding of the historical context of phenomena under investigation is required. This limitation of the survey method was tackled by gathering historical data through a review of secondary literature about the history of treaties, policies, regulations, and contractual agreements. Interviews were also conducted to secure more personal narratives and a deeper insight into issues associated with collaborative relationships and technology transfer.

To be able to gain a profound insight, interviews were used in this research both as a source of primary data and as a complement to other sources. In this regard McNamara (1999) pointed out that interviews are useful to follow-up responses to questionnaires. Qualitative interviewing is one of the most common ways in which the 'hows' and 'whats' of people and their lives can be studied (Fontana and Frey 2005). It also manifests specific characteristics that make it an extremely versatile approach to doing research (Berg 1998).

In conducting the interviews a general frame was used to as a guide, usually a semi-structured approach. However, the study did not follow a strict frame as the interviewees often expanded on interesting issues that were not included in the initial framework.

As the research proceeded, modifications of the questions, based on experience in the field and results of primary analysis, were made in order to make them more suitable for the study. In the semi-structured interviews the protocol was developed using open-ended questions based on the central focus of each research chapter before data collection in order to obtain specific information and enable comparison across cases. The interviews nevertheless remained open and flexible so that individual participants' stories could be probed in more detail. As some social researchers have argued, this technique (semi-structured interviews) allows the interviewees to freely express their viewpoints while also allowing the researcher to guide the interview (Kvale 1996; Flick 2009).

A copy of the interview protocol was sent to those participants (especially to the higher officials) who asked for it before the interview took place, though these were relatively few. Pre-testing of the interview protocol was also conducted to get feedback on individual questionnaire items, to intercept possible problems with terminology, and to get an indication of how respondents may answer some of the questions.

Each topic area was introduced by the researcher with an open-ended question that allowed spontaneous expression by the respondents in answering the questions, as well as further in-depth probing by the interviewer where necessary. The research also employed an almost totally unstructured interviewing technique. In this technique the researcher usually asked a single question and the participants were then allowed to respond freely, with the researcher simply responding to points that seem worthy of being followed up. Burgess (1984) argues that unstructured interviewing tends to be very similar in character to a conversation.

This type of interview was used mainly when the researcher met participants in conferences and other events and the interview was very much 'conversational' in style. The first focus of this interview was putting the participants at ease while also explaining fully and clearly in what ways the researcher was hoping for help and then a more detailed interview was conducted in a form of relaxed conversations. The conversations were taken place in conference rooms, offices and sometimes even during a car journey and over meals. The respondents were aware that they were being interviewed for research purposes. The main content of the conversations consisted of comments, discussion and questions about the climate policy conferences, Ethiopia government technology transfer approaches and views about different actors of technology transfer.

Participants in the unstructured interviews were chosen based on their knowledge and expertise to provide the information needed. They were recommended by several sources and acted as key informants, also referred to as key consultants (Werner and Schoepfle 1987), and provided in-depth, expert information on elements of international climate technology transfer. Though these unstructured interviews (key informant interviews) were like a conversation among acquaintances and allowed a free flow of ideas and information, notes were taken and developed in detail immediately after each interview to ensure accuracy. A set of common subheadings was also used to ease the data analysis that was conducted concurrently with the data collection.

When collecting non-sensitive information, focus group discussions were used to understand differences in perspectives and explore the depth and nuances of opinions regarding international climate technology transfer and technological cooperation approaches of the Ethiopian government.

In order to generate in-depth descriptions of climate technology transfer, an observational data collection method was used in all three levels of climate technology transfer. Observation was conducted during climate change conferences, UNFCCC Convention subsidiary bodies meetings, and national workshops on the Ethiopian Growth and Transformation Plan (GTP) and manufacturing and production operation of selected companies in Ethiopia. The observation method was used for obtaining information on actors' actions, roles, behavior and interactions that were otherwise inaccessible.

A case study method following the approach of Yin (1984, 1992, 1994 and 2003) was also employed. Multiple case studies that observe a number of cases and their context were chosen for the purpose of analyzing local level climate technology transfer. The chosen case studies provided qualitative information about what constitutes successful technology transfer and what are the key enabling factors. They highlight the particularities of climate technology transfer in the context of a least developed country. Yin (1984 and 1992) pointed out that in a case study approach data collection should include multiple sources. Data sources for the selected case studies of local level transfer of technology analysis included review of public and non-public documents, interviews, survey, and observations.

3.2.1 RESEARCH ACCESS AND ETHICAL CONCERNS

Entry into the research domain of international climate technology transfer was challenging and quite difficult. A large number of communications (emails and voice mails) made to initiate contact with various delegates of countries at the climate conferences under the UNFCCC were left unanswered, despite repeated attempts; others were politely declined.

Denial of access to the researcher and data acquisition limitations were not restricted to delegates of countries at the UNFCCC climate policies, but also with the Ethiopian authorities, and to some extent to industrial communities. This access denial issue, while frustrating and a limiting factor to this inquiry, was not entirely surprising. The researcher has been working for international organizations and that background has provided concomitant knowledge of the concern of government representatives for revealing their positions outside the negotiation rooms. That knowledge, coupled with an understanding of climate change policy debates as major process in world politics, made denial of access not entirely unexpected even before this inquiry commenced. In addition, data collection for the international level study was made in 2009 at the Copenhagen Climate Conference, which attracted a great deal of attention. The researcher of this doctoral thesis, with a full understanding of all these circumstances, carefully considered access when designing the research.

To counter the problem of research access, Johnson (1997) proposes incremental access strategies that rest on the principle of building positive relationships and establishing credibility. Social science researchers argue that the strength of the interviewer-participant relationship is perhaps the single most important aspect of a qualitative research project. It is through this relationship that all data are collected and data validity strengthened (Adler and Adler 2002; Kvale 1996). It was the quality of this relationship that likely affected some participants' self-disclosure, including the depth of information they shared about their experience of the international climate policy negotiations, Ethiopia climate policies and the effectiveness of technology transfer. At first contact during the interviews, participants expressed feeling guarded while discussing their experiences. Had they not felt at least some sense of safety with the interviewer, they likely would not have been forthcoming in discussing these difficult events at all.

To access data and recruit interviewees, the researcher made use of two central techniques; namely, gatekeepers and snowballing. Firstly, gatekeepers "are those individuals in an organization that have the power to grant or withhold access to people or situations for the purposes of research" (Seidman 1998). Snowballing, on the other hand, is the use of "one contact to help you recruit another contact, which in turn can put you in touch with someone else" (Seidman 1998). These methods are useful as they can overcome the problems that arise when the researcher tries to find relevant informants (Bryman 2001). Moreover, gatekeepers are imperative for any study as they are often the first "load of snow" necessary for expanding the snowball (Bryman 2001).

The main gatekeepers in this research were higher government and political party officials, company senior management members and officials at the UNFCCC, government agencies and private companies in various capacities. Gatekeepers were useful in this research not only because of their local influence but they had power to add credibility and validity to the research by their acceptance of it.

The researcher used his personal contacts with gatekeepers at the secretariat (UNFCCC) in Bonn, various ministerial offices in Addis Ababa, and other countries to gain access to organizations and increase participation in the research project. Once gatekeepers had identified initial participants, a snowballing technique was used to enhance the variety of participants. As Seidman (1998) has commented, introductions from gatekeepers helped to even out inherent power relations as a known person introduced the researcher to the participant. The researcher was perceived as "friend of a friend," whereas the participant was viewed as an expert on his or her own experiences.

The researcher was fortunate to have privileged access to higher government officials in climate conferences and other high profile related international conferences, for example,

he had the chance to meet and organize interviews (especially unstructured interviews) with higher government officials in Bonn, Addis Ababa, Brussels, Washington, Cape Town, Brasilia, Beijing, Istanbul, Cairo, Abu Dhabi, Mauritius and Oslo. These higher government officials served as key informants and also as gatekeepers. They introduced the researcher to other potential participants (a snowballing technique). There are also, as argued by Seidman (1998), drawbacks to the use of snowballing: it can result in a restricted sample of participants drawn from similar backgrounds¹.

The value of the study was explained to each and every participant in different instances and in fact, most participant organizations found the research valuable as they faced their own questions about the interconnections of the three decision-making structures for international climate technology transfer.

During the data collection stage, the researcher strived not only for accuracy but also preserved the right of each participant to withdraw or decline to take part in the research. The researcher informed the participant interviewees about the objective of the inquiry and that they are free to cancel their participation whenever they want. The names of the interviewees have been published with their consent and all were offered anonymity and informed about confidentiality.

3.2.2 LEVELS AND UNITS OF ANALYSIS

This multi-leveled analysis of international climate technology transfer adopted three levels of analysis as an analytical concept. In social science study “levels of analysis” refer to sets of causal processes (each representing different degrees of organizational complexity), or pointers to the location, size, or scale of a research target; and refers to a more or less integrated set of relationships (Sawyer 2002; Simon 1962; and Kontopoulos 1993). There are three general structural levels into which social research may fall: macro, meso and micro (Gell-Mann 1994; Yurdusev 1993). On the other hand, the units of analysis are the primary components being analyzed in the study (Trochim 2006) and it could be individuals, team, formal organization, or a state (De Vaus 2006). Yurdusev (1993) has argued, there can be no separation between “level of analyses” as an issue of how to methodologically study the object, and “unit of analyses” as an issue of what to study, because they link to each other through the idea of the ‘whole’.

In social science, micro-level is referred to as the local level and examples of micro-level units of analysis include persons, families, or neighborhoods. Meso-level refers to analyses that are specifically designed to reveal connections between micro- and macro-

¹ Gatekeepers and snowballing approach could introduce considerable bias in participant selection. Please see Section 3.3 for the steps the researcher took to avoid bias.

levels. Meso-level units of analysis include community, clan, or state. Macro-level is referred to such as the global level and examples of macro-level units of analysis include international, society, or civilization. In the literature of international studies, levels are comprised of three layers for analysis: – individual (sub-national), state, and international system (Rourke 2005; Singer 1961).

This thesis focus on levels of causal processes as differentiated both in social and international political research to study and identified three levels: (1) the preferences of developed and developing countries to international climate technology transfer under the UNFCCC (International-level analysis) (2) the national approaches to international climate technology transfer (State/National-level analysis) (3) the international technology transfer practices at the firm level (Local/Firm-level analysis).

Choice of the levels of analysis was rooted in the objectives of the thesis and research questions. The research question asks about the nature of the relationship between firm practices, national policies, and international discourses for climate technology transfer. Choosing the three layers to the international climate technology transfer as a research level of analysis was therefore inevitable. Analyzing and understanding of the international climate technology transfer requires addressing the complex questions of scale and definition through innovative interactions of the three layers.

The firm-level analysis (Micro-level analysis) broadened the company study in order to understand what the importance of technology transfer is to firms, how new capabilities were acquired, and what kind of technology transfer modalities the firms are adopting. This level of analysis helped to analyze a broader picture of international technology transfer dynamics within the firms and level of influence of national policies and technology transfer approaches. Three firms that involved a large set of actors from both the global south and industrialized world were selected as case studies. These selected firms shed light on the various channels of technology transfer and could feature the complex political economy of climate technology transfer. These three firms are the unit of analysis for this level of study (Unit of analysis 3).

The national-level analysis (Meso-level analysis) was carried out by investigating the Ethiopian government technology transfer approaches in the context of the international technology transfer discussions under the UNFCCC. The Government of Ethiopia serves as the unit of analysis for the state-level analysis of the thesis (Unit of analysis 2). The views and opinions of those firms selected as case studies for the third unit of analysis were also included in the second unit of analysis.

The analysis for international level technology transfer (Macro-level analysis) was done in the context of its value for the micro-level (firm practices) and meso-level (national

experiences) technology transfer. The international-level analyzed incompatible preferences between the developed and developing countries on what institutions under the UNFCCC are doing for moving up the international negotiations on Technology Transfer. The unit of analysis for this level, therefore, is the UNFCCC (Unit of analysis 1). However, as argued by Yurdusev (1993) and others in the study of international relations, this thesis doesn't make a clear distinction between the three levels of analysis and the respective units of analysis.

3.2.3 ANALYTICAL PROCEDURE AND TECHNIQUES

The qualitative data analysis processes in this research run concurrently with the actual data collection, because analytical steps inform the process of additional data collection, and new data informs the analytical processes (see Section 3.2). The theoretical lens from which the researcher approaches the phenomenon (see Section 3.2.4), the strategies that the researcher uses to collect or construct data (see Section 3.2), and the understandings that the researcher has about what might count as relevant or important data in answering the research question (see Section 3.1) are all analytic processes that influence the data (Patton 2002; Rubin and Rubin 1995). The main purpose of data analysis in qualitative research is to organize the information so as to present a narrative that explains the meanings, feelings and opinions that underlie the behavior of the participants in the study (Rubin and Rubin 1995).

This section presents analysis as an explicit step in conceptually interpreting the data set as a whole, using the constant comparing method. Three major stages characterize the constant comparison analysis (Strauss and Corbin 1998). During the first stage (open coding) the data are divided into small units then, during the second stage (axial coding) these codes are grouped into categories. Finally, in the third and final stage (selective coding) the researcher develops one or more themes that express the content of each of the groups (Strauss and Corbin 1998). These three stages explain how in this research data were sorted, organized, conceptualized, refined, and interpreted. It should be noted that these stages are simply the overarching approaches of the research. The stages were not strictly followed each of the research chapters of this thesis, as each chapter employed a slightly different analysis technique. Despite the slight differences in the analysis techniques, the three research chapters followed the following analytical procedures.

(1) Emerging patterns or trends, strongly held opinions and frequently held opinions were noted. At the end of each interview and observation an 'interview summary' sheet was prepared, reducing information into manageable themes, issues, and recommendations. Each summary provided information about the key informant's position, reason for inclusion in the list of participants, main points made, implications of these observations, and any

insights or ideas the researcher had during the observation and interview. Sections of the notes that relate to each question/issue were highlighted and participant comments that may be worthy of future quotation were marked.

(2) Descriptive codes were used to organize responses; however, numeric codes were not appropriate for this research. In the multiple data collection method, and where open-ended questions are the primary techniques, coding principles were used to organize the responses into categories that identified and brought together corresponding themes (Rubin and Rubin 1995). The codes covered key themes, concepts, questions, or ideas, such as country position on the bargaining points of the international policy debates under the UNFCCC; and policies, approaches, motivations, characteristics, and experiences of climate technology transfer in Ethiopia. Categories and subcategories for coding based on key study questions were developed. For the initial set of questions and observations, formal coding approaches for analyzing the data were not planned, as the interview schedule provided for questions covering predetermined themes and issues.

The overall flexibility of the interview schedule, however, resulted in participants' answers sometimes deviating from the planned order of the questions and also additional issues being discussed. This meant that, where necessary, responses had to be grouped together so that coincidental concepts and themes that emerged from the conversations could be examined. Notes, memos, transcribed interviews were read paragraph by paragraph and word by word, the themes and categories were marked as they appeared, and after a code for each paragraph had been provided, the themes were grouped together.

This grouping of like with like, data bits with data bits, created the categories of the data, which became the basis for the organization and conceptualization of the research data, "categorizing, therefore, is a crucial element in the process of analysis" (Dey 1993). Content analysis, or analyzing the content of interviews and observations, is the process of identifying, coding, and categorizing the primary patterns in the data (Patton 2002). Dey (1993) argued when a particular category is adopted, a comparison is already implied and he further asserted that the process of developing categories is one of continuous refinement; therefore, flexibility is required to accommodate fresh observations and new directions in the analysis.

(3) This assertion of Dey's leads to the final stage of the analysis where more and more decisions were made about which bits of data can or cannot be assigned to the category and in the process themes that expressed the content of each category were developed. Survey and interview questions were examined continuously and the coding categories were revised throughout the data collection and early analysis process. During the course of the analysis, the criteria for including and excluding data, rather vague in the beginning, became more

precise. Categories were defined and redefined by specifying and changing the criteria used for assigning them to the data. In so doing, it was recognized that the definitions developed in the beginning were quite general and contingent in character. "In defining categories, therefore, we have to be both attentive and tentative - attentive to the data, and tentative in our conceptualizations of them" (Dey 1993).

To visualize findings more clearly, quickly, and easily the research data were presented mainly in a table format. Reliability of data was examined including assessing participants' knowledgeability, credibility, impartiality, willingness to respond, and presence of outsiders who may have inhibited their responses. Greater weight was given to information provided by more reliable respondents. The results of early major findings of the research chapters were sent to key informants for feedback. Their feedback along with the early analysis approach enabled the researcher to take another look at the research method and collect further data, which is why an early and continual analysis approach was an appropriate strategy for this research. Finally, a report that reflects back to the objectives of the study, and the information needed by the research, was prepared. The descriptive report summarized comments, observation of participants, and analytical reports that highlight key findings.

3.2.4 THE ROLE OF THEORY

This research employed multiple theories in the research framework in order to examine the multi-leveled nature of international climate technology transfer. Theories as a conceptual and methodological tool are necessary since facts alone cannot be employed to answer questions posed in the study of reality (Marsh and Stoker 1995). Thus, theories as methodological instruments explain 'the real world' and bring concepts together in a perspective of shaping potential maps that interpret the international climate technology transfer system.

This research first drew on historical institutionalism to investigate the causes for the lack of ambitious international climate technology transfer agreements. It also employed international regime theory, most notably drawing on its three core concepts namely power, interest and knowledge to explain the basic problems in global climate negotiations and to examine the asymmetry in parties' interests and demands for climate technology transfer under the UNFCCC. The international environmental regime as an analytical approach is the dominant theoretical lens for the study of bargaining processes and international rule-based co-operation (Hasenclever et al. 1997; Keohane 1989; Young 1989), and much of the effort to interpret international climate co-operation has proceeded from the basis of the regime approach (Keohane 1989).

The research also took advantage of pertinent insights from development theorists to investigate whether and how the Ethiopian government development approaches and its engagement in south-south cooperation accelerate the transfer of climate technologies. Dependency theorists view SSC as a possible source of self-reliance for the South, and SSC as an alternative to NSC, which they consider an almost subversive strategy to strengthening developing countries both politically and economically (Smallman and Brown 2011). They argue that technology transfer is just one more area through which the center (the North) consolidates its economic and cultural domination over the periphery (the South) (Darity and Davis 2005). On the other hand, the realist school of thought views SSC as a political strategy employed by regional powers (i.e. BICS: Brazil, India, China, and South-Africa,) to have weaker states like Ethiopia under their control, thereby elevating their influence in the international arena (Schweller 1997). Consequently, from the realist perspective, real cooperation among states is unlikely and SSC is a strategy used by the dominant emerging southern states to secure power (Mundy 2007). SSC, as a realist school of thought would argue, is promoted by regional hegemonic powers (BICS) to consolidate their dominance and influence and it would be effective as long as it doesn't diminish their power (Karns and Mingst 2004; Woods 2001).

This research also employed a combination of actor-network theory (ANT) and the theory of absorptive capacity (TAC) as theories to examine the effectiveness of technology transfer at the firm level. ANT is used as a conceptual framework for analysis to investigate the degree and form of continual mobilization of global and the local networks; and the way in which they are connected to determine the success of the set goals of international technology transfer. It helped to understand how associations in climate technology transfer come into existence; and how the roles and functions of subjects and objects, actors and intermediaries, humans and non-humans are attributed and stabilized (Murdoch 2001). More specifically, ANT's treatment of technology transfer as a complex socio-technical and heterogeneous network comprising actors, institutional arrangements, textual descriptions, work practices and technical artifacts (Garrety et al. 2001) has a particular appeal for this study. Although the use of ANT to understand the effectiveness of technology transfer at the micro level offers a natural starting point for addressing the research questions, the study also employed TAC as a possible addition to help with further understanding. One of the main motivations for including TAC in the analysis was that it offered additional insights with regard to the absorptive capacity of receiving organizations. The absorptive capacity of host countries, as argued by Lovett et al. (2012), is a key element for effective technology transfer. TAC as a conceptual and methodological tool for the development of research practice examined firms' ability to sense their information environment, to recognize new

technological opportunities and to capture and integrate new information and knowledge into the firms' processes and routines with the subsequent aim and result of increased competitive advantage (Lane and Lubatkin 1998). The objective of using a combination of these two perspectives was to accentuate issues of technological information access and assimilation of climate technology transfer.

3.3 RELIABILITY AND VALIDITY

The nature of this specific study, which interviewed policy makers, negotiators at the international climate policy discussions, industrial experts, and scientists, was aimed to obtain as wide a scope as possible on the interpretations, experiences and actions of the participants regarding the topic under investigation. This dictated that different criteria be taken into account to ensure reliability and validity. Reliability has to do with the quality of measurement, with how consistent the measurements are, or how reproducible the set of results are (Trochim 2006). Validity concerns methodological soundness or appropriateness, and refers to whether the concepts being investigated are actually the ones being measured or tested; it thus serves as a framework for assessing the quality of research conclusions (Patton 2002; Trochim 2006).

To ensure the quality of this research several approaches were employed:

(1) Triangulation of data from the multiple data sources. This triangulation served as the primary strategy to check and validate the accuracy of the thesis findings. Triangulation involves the use of two or more independent sources of data and tests their consistency (Mathison 1988; Patton 2002). The strength of triangulation in qualitative research lies mainly in the area of data analysis as it adds credibility to and confidence in any conclusions has drawn (Patton 2002). Various kinds of triangulation can be used, the central idea of them all being the combining of different methods, theories and so forth to study the same phenomenon, with the aim of testing for consistency of results (Patton 2002). This thesis used multiple research methods, which as Johnson (1997) argued, could facilitate a more valid and reliable construction of realities through data triangulations to accurately record a particular construction of reality. The process of triangulation in this thesis was conducted by correlating the different data sources. Responses to the survey questions were compared to interview data and focus group discussions and review of documents.

(2) Credibility and conformability refers to the degree to which the researcher demonstrates that the results and conclusions are believable from the perspective of the research participants, and the degree to which the results can be confirmed or corroborated by others (Patton 2002). The results of early major findings of the research chapters were sent to key informants for feedback. As additional means of assuring the credibility and conformability of

methods and results, the terms/principles according to which the results were interpreted were checked with knowledgeable persons, such as experts of some research techniques like ANT, and others experts in the field under study, such as colleagues at the secretariat (UNFCCC), Addis Ababa University (Ethiopia) and the World Bank. In addition, the appropriateness of the terms of reference used for interpretation was fairly obvious as they were taken from the subject literature.

(3) Consistency is another criterion to ensure the quality of the research. The concepts and themes that emerged from the data collection techniques and settings were carefully organized according to themes and documented; and as Patton (2002) pointed out this measure arguably attests to consistency across the cases in the research. The concurrency analysis approach along with the iterative explanation building was also helpful to ensure the consistency and dependability of data.

(4) Researcher bias was also checked to confirm the quality of this research study and the conclusions drawn from the results. Flick (1998) and Patton (2002) argue that a researcher can potentially bring bias into a study, for example by influencing participants in some way or another, selecting data that best supports the theory, or bringing personal perspectives into the analysis and interpretation of data. As the researcher of this doctoral thesis has been working in the climate change issues for years, his own biases as an investigator was examined, including tendencies to concentrate on information that confirms preconceived notions, seek consistency too early and overlooking evidence inconsistent with earlier findings, and being partial to the opinions of elite key informants.

(5) In addition to a scrupulous application of the criteria discussed above to ensure the quality of the methods applied in conducting a research project and analyzing its results, which would inevitably contribute to solving or minimizing the potential problem of bias, the openness and honesty of the researcher with the participants, and his clarification of all aspects of the research topic with them before the interview commences, help to minimize bias (Flick 1998). In this study, the underlying goals of the study were explained when the meetings were set up and also discussed at the start of and during the data collection (see Section 3.2). In the matter of bias, impartiality is critical if a researcher is serious about proving that the findings of the research reflect the ideas of the participants and their situation, and not the motivations and perspectives of the researcher (Patton 2002).

The impartiality of the researcher was attested to by the fact that there was no specific reason for consciously or unconsciously constructing a biased version of his experiences. Nothing had to be “proven”, as the researcher entered into the study without any hypotheses to test, or any preconceived ideas regarding the issues at hand or the outcomes of the study. No expectations or guidelines were specified for the research which was purely to explore

and thus gain understanding of the phenomena surrounding the relationships between the three levels of decision making structures in international climate technology transfer as experienced by its central role players. In addition, the academic character of the research was highlighted when contacting the research subjects in particular those whom the researcher contacted them through friends and colleagues (snowballing).

After the introduction was made the researchers' friends and colleagues were not involved. In research of this kind, where having a range of participants is key to achieving the study objective, the snowballing technique can be somewhat tautological and, indeed, could jeopardize the data and impartiality of the researcher. Because of such drawbacks, the researcher used survey questionnaires in addition to interview and observation research methods.

In order to avoid any attempt from gatekeepers to influence the research process with their own version of "reality" by only indicating participants "approved of" by themselves, all gatekeepers and their recommendations, although respected, were treated with some degree of caution. The guiding principle of the research was one of inclusiveness to include as many views and narratives as possible. To enhance reliability of the research, the academic character of the research was highlighted when contacting research subjects, in particular those whom the researcher contacted through friends and colleagues. The concurrency analysis approach, together with iterative explanation building, was important for ensuring reliability of data. The demonstration of accuracy of the results through all these methods served to enhance the overall data analysis and to consequently enrich the findings and conclusions of this doctoral research.

CHAPTER 4 HISTORICAL INSTITUTIONALISM IN THE UNFCCC: INCOMPATIBLE PREFERENCES AND BARGAINS AT THE COPENHAGEN CLIMATE CONFERENCE

4.1 INTRODUCTION

4.1.1 BACKGROUND

The objective of this chapter of the thesis is to investigate causes for the lack of ambitious international climate technology transfer agreements. It will draw on the concept of historical institutionalism and demonstrate that institutional structures put in place in the 1992 climate change agreements have been difficult to change.

The chapter will examine the origin and structure of countries' incompatible preferences and bargains under the United Nations Framework Convention on Climate Change (UNFCCC). Historical institutionalism explains the case of international regimes established by countries with divergent, often conflicting preferences, remaining in place even when conditions have changed markedly. This results in a gap between the founders' goals and the design features they select to achieve them (Pierson 1996). Central to this idea is that initial choices made at institutional foundation become 'locked in' and difficult to change, especially if they exhibit 'positive feedback', i.e. each action confirms the validity of the previous choice (Katznelson and Weingast 2005). The institution then becomes 'path dependent' and difficult to change from a course plotted in the past, even when there is a demonstrably more effective and efficient course available. Under conditions of historical intuitionism, incremental changes could result in substantial future changes, but these changes are constrained by being path dependent. The proposition that there are divergent, often conflicting, preferences in the establishment of institutions, and the exploration of international negotiations as path dependent, and characterization of some agreements and institutions as entrenched and resistant to reform, is central to this chapter of the thesis.

This chapter specifically examines the substance and processes of the 2009 Copenhagen Climate Conference negotiations and reviews policy positions of countries on international environmentally sound technology transfer as a climate change mitigation mechanism. During the 2009 Copenhagen Climate Conference the negotiations engaged in a fundamental political bargain directly involving technology transfer, but the deep divisions

between the developed and developing countries affected the bargaining processes and the quality of its outcome.

The first Conference of the Parties (COP) meeting under the UNFCCC, held in Berlin in 1995 interpreted the principle “common but differentiated responsibilities”, which was introduced in 1992. That interpretation formalized the divide between the global North and South countries in order to recognize the role of historical polluters in contributing to greenhouse gas concentrations. The aim was to allow developing countries to develop without a cap on emissions and encourage them to adopt environmentally sound technologies. The US senate reacted to inclusion of the principle of differentiated responsibilities in the 1997 Kyoto Protocol by passing the Byrd-Hagel Resolution in 1997, stating that the USA would not ratify a treaty without the full participation of developing nations in agreeing to binding emissions targets. The Byrd-Hagel Resolution, with its complete rejection of the UNFCCC principle of differentiated responsibilities, together with a lack of binding commitments for developing countries, prevented the USA from signing the Kyoto Protocol, effectively delaying its entry into force to the point where it was no longer particularly relevant.

This research demonstrates that once an agreement has been negotiated between a large numbers of countries, then it is hard to change to another path due to inbuilt inflexibility in the establishment of the international institution. The Copenhagen 2009 international climate negotiations demonstrated only incremental changes in the historical stance of countries on climate technology transfer.

The principle of differentiated responsibilities, dating from the birth of the UNFCCC, was a major sticking point in Copenhagen and subsequent meetings preventing concrete forward movement in the international climate policy negotiations. Incompatible preferences and deep divisions between the developed and developing countries characterized the 2009 Copenhagen Climate Conference. This asymmetry in parties’ interests and demands are rooted in the principle of "common but differentiated responsibilities", which is seen as one of the key principles of the UNFCCC.

OVERVIEW OF THE CHAPTER AND RESEARCH QUESTIONS

This chapter of the thesis explains the reasons for the difficulties in developing a concrete international policy on climate technology transfer. The chapter specifically analyses the asymmetry in parties’ interests and demands on international climate technology transfer under the UNFCCC negotiations in Copenhagen both in terms of substance and process.

The contribution of this chapter of the thesis is two-fold: 1) the chapter provides insights on the origin and structure of countries' incompatible preferences and bargains on climate technology transfer in international climate policy; 2) based on the results of the analysis, the chapter provides insights for exploring the reasons for accords and disjunctions that could exist between international climate technology transfer debates under the UNFCCC, national policies and priorities for climate smart institutions (to be discussed in Chapter 5) and effectiveness of technology transfer at the firm level (to be discussed in detail in Chapter 6).

Against this background, this part of the PHD study is guided by the following research question:

Why did countries fail to reach ambitious climate technology transfer agreements?

Based on this overarching question the specific research sub-questions are:

- i. What were the preferences of developing and developed countries for promoting and implementing climate technology transfer?
- ii. What was the origin and structure of countries' incompatible preferences and bargains?
- iii. How was the quality of the Copenhagen Conference outcome affected by the incompatible preferences and bargains of the parties?

4.1.2 METHODOLOGY

The data collection methods used in this part of the thesis were interviews, focus group discussions and direct observations of the negotiations. Collection of primary data on international climate technology transfer negotiations was not easy. 40 of the 51 emails sent out to country delegates to the UNFCCC and Ad hoc Working Groups (AWGs) to initiate acquisition of data were unanswered. In addition, most delegates were not comfortable about revealing their positions and discussing their preferences outside of the negotiation rooms.

To counter the problem related to access and recruiting of interviewees, the researcher used his contacts at the secretariat (UNFCCC) in Bonn and various countries such as in German, Ethiopia, China, Belgium, Ghana, Mexico, Norway, Mauritius, etc. Use of direct personal researcher contacts in those countries and agencies helped to enhance credibility, establish positive relations, and gain access to delegates of other countries and recruit interviewees. The development of positive relationships and the affirmation of researcher credibility helped to obtain the depth of information and persuade delegates to share their experience of the international climate policy negotiations.

This research employed both structured and unstructured interviews. In both cases open-ended questions were used. The unstructured interview (key informant interview), was very much 'conversational' in style and was used to secure more personal narratives and a deeper insight into issues associated with countries' positions on climate technology transfer.

These interviews were conducted when the researcher met participants in climate change events such as in the 32nd sessions of the UNFCCC Convention subsidiary bodies, which took place from 31 May to 9 June 2010 in Bonn, and the thirteenth session of the AWG-KP¹ and the eleventh session of the AWG-LCA², which took place from 2 August to 6 August 2010 in Bonn. During these events, information on delegates' and non-state actors' actions, roles, behaviour and interactions was obtained by direct observation. Phone interviews were used to follow up the results of the unstructured interviews and observations made during the climate change events. The interview questions were communicated to participants by email before the interviews. In order to get as much information from the delegates as possible, the phone interviews were conducted when it was convenient for them. A total of 35 participants from 22 countries were interviewed by phone. Most of the participants were not happy with tape recording of the conversation; therefore, written notes were taken when participants spoke.

Focus group discussions were also conducted on August 4, 2010 with non-government actors including the World Resource Institute, Wuppertal Institute, Pakistan Climate and Development Knowledge Network (Pakistan-CDKN), World Business Council for Sustainable Development (WBCSD), and University of Cape Town. The objective of the focus group discussion was to understand differences in perspectives and explore the depth and nuances of opinions regarding international climate technology transfer. As it was done for each interview and conference, detailed notes were taken and developed after the focus group discussion to ensure accuracy. As the method of data collection proceeded from observation to unstructured interview to focus group discussion and then to phone interview, modifications of interview questions based on the experience in the field and results of primary analysis were made in order to tailor them for the study. Historical secondary data were used to back up the primary data collected through interviews, observation and focus group discussion. The historical data included reviewing the processes and documents of previous climate change conferences and results of preceding negotiations and agreements.

Data evaluation was conducted in an on-going iterative basis in which data was continuously collected and analyzed almost simultaneously. Interviewee responses,

¹ Ad hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).

² Ad hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA).

observation reports and discussion notes were constantly compared with each other and recurring themes, new topological dimensions, as well as new relationships, were discovered.

This chapter employed theories as methodological instruments to bring concepts together with the perspective of shaping potential maps that interpret the international climate regimes in relation to the debates on climate technology transfer. Historical intuitionism along with the international regime school of thought was employed as a conceptual framework for analysis to examine the countries' incompatible preferences and bargains for climate technology transfer under the UNFCCC and to explain the origin and structure of the asymmetry in parties' interests and demands in global climate negotiations. Historical institutionalism proceeds through a constant movement back and forth among cases, questions, and hypotheses. Historical institutionalisms analyze macro contexts and hypothesize about the combined effects of institutions and processes rather than examining just one institution or process at a time. This helped focus the research, by examining the climate institution both in terms of process and substance to effectively employ an iterative process of data analysis. Historical institutionalisms analyses organizational configurations over time, whereas others look at particular settings in isolation; and pays attention to critical junctures and long-term processes where as others look only at slices of time or short-term manoeuvres.

It should be noted that no single international regime approach is adequate to explain and effectively analyze the global climate negotiations and development of the climate change regime during the Copenhagen Climate Conference. The solution employed in this chapter is to broaden the regime model slightly by incorporating three core concepts of the approach namely power, interest and knowledge and to build into this framework some of the key insights offered by historical institutionalism.

The international environmental regime as an analytical approach is the dominant theoretical lens for the study of bargaining processes and international rule-based co-operation (Hasenclever et al. 1997; Keohane 1989; Young 1989), and much of the effort to interpret international climate co-operation has proceeded from the basis of the regime approach (Keohane 1989). In the regime school of thought there are important differences in emphasis and understandings of the negotiation process through which regimes are created, the factors that are important and the extent to which regimes matter. For instance, in power-based theories (theory of Hegemonic Stability) the dominant power sets up a hegemonic system of itself or international management and determines the basic principles, norms, rules and decision-making procedures of the system (Grieco 1988; 1993). Utility-based approaches, on the other hand, emphasize that states are self-interested, regimes are

developed in part because actors in world politics believe that with such arrangements they will be able to make mutually beneficial agreements that would otherwise be difficult or impossible to attain (Keohane 1989). A third strand is the constructivist approach where emphasis is placed on consensual knowledge and a regime will be formed mainly when there is common knowledge or understanding on the nature of the issue and what needs to be done to achieve a solution (Litfin 1994; Haas 2004).

Historical institutionalism on the other hand considers the particular historical contexts in which international regimes are born and in which they must survive (Katznelson and Weingast 2005). It recognizes that the extent of countries' divergent preferences is highly contingent on past decisions and no decisions that characterize international negotiations. Tensions within founding coalitions mean that no one group of actors predominates in specifying an institution's structures and functions (Pierson 2004). Historical institutionalism also tends to be more focused on how the behaviour of political actors shapes the nature of diverse forms of incremental change than on the type of large structural transformations (Capoccia and Kelemen 2007).

This chapter of the thesis is organized in eight sections. This section is devoted to presenting a brief background of the chapter, research questions and methods of the research including the overarching approaches and theories for examining the incompatible preferences and bargains at the international climate policy negotiations. The second section assesses the UNFCCC historical pathways mainly from the perspective of technology transfer negotiations. The third section examines the debates that were carried out in the Ad Hoc Working Group on Further Commitments under the Kyoto Protocol (AWG-KP). Sections 4, 5 and 6 examine the most common issues of contention in the climate technology-transfer negotiations in the 2009 Copenhagen Conference. Section four explains the type of organizational structure and power that the technology transfer organizations should wield. Section 5 details the discussions around whether additional instruments are necessary for Intellectual Property Rights (IPR) or not. Section 6 assesses the asymmetry in parties' interests on how much money should be contributed, from what sources, and with what governance arrangements. Section 7 presents the consequences of the incompatible preferences of developing and developed countries. The last section (Section 8) provides a concluding discussion.

4.2 FOUNDING MOMENTS: THE FORMALISATION OF THE NORTH-SOUTH DIVIDE

The events in Copenhagen had their basis in what happened during the period leading up to COP 15: "the seeds of the diverse problems that beset the Copenhagen Conference were sown long before it opened" (Müller 2010). In an historical institutionalism perspective, policy

choices made when an institution is being formed, when a policy is initiated, or during first generation decisions, have a continuing influence over the negotiations far into the future (Pierson 2000). The initial institutional formations will persist and become 'path dependent' and the forces of inertia take over (Hall and Taylor 1996). Therefore, it is worthwhile taking note of the discussions on technology transfer in the time leading up to COP 15 before turning to the 2009 Copenhagen bargains on technology transfer. The following section examines the UNFCCC historical pathways mainly from the perspective of technology transfer negotiations.

The role of technology cooperation and transfer in achieving the stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system has been recognized in the UNFCCC's goals since the convention came into force in 1994 (UNFCCC 1994). The UNFCCC, adopted at the U.N. Conference on Environment and Development (the first "Earth Summit") in Rio de Janeiro, Brazil, in 1992, contains what has become a crucial passage. The first "principle" in Article 3 of the Convention reads as follows: "The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof." The phrase – common but differentiated responsibilities – has been repeated countless numbers of times in policy documents since the UNFCCC was adopted in 1992 in the first "Earth Summit" in Rio de Janeiro.

The principle of "common but differentiated responsibilities" was interpreted in the Berlin Mandate, which was agreed three years after the Earth Summit in the very first Conference of the Parties of the UNFCCC (COPs) in 1995. The Berlin Mandate interpreted the principle of "common but differentiated responsibilities" as: (1) launching a process to commit (by 1997) the Annex I countries (developed countries) to quantified greenhouse gas emissions reductions within specified time periods (targets and timetables); and (2) stating that the process should "not introduce any new commitments for Parties not included in Annex I (developing countries).

Thus, the Berlin Mandate effectively established the dichotomous distinction between the global South and North countries. The Berlin Mandate codified with numerical national targets and timetables for Annex I countries (developed countries) in the 1997 Kyoto Protocol. It was in direct response to this Mandate that the US Senate subsequently passed unanimously (95-0) the Byrd-Hagel Resolution on 25 July 1997 (Senate Resolution 98, 105th Congress, 1st Session) stating that: "It is the sense of the Senate that the United States

should not be a signatory to any protocol to, or other agreement regarding, the United Nations Framework Convention on Climate Change of 1992, at negotiations in Kyoto in December 1997, or thereafter, which would mandate new commitments to limit or reduce greenhouse gas emissions for the Annex I Parties, unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period.” The resolution represented a powerful signal that a Kyoto-type agreement, which arguably violated both conditions specified in the resolution (developing country participation and serious harm to the economy), would not receive the support of the required two-thirds majority of the Senate. The first periods of the UNFCCC negotiations were dominated by the gulf between European Union and the USA though their policy differences were less significant. The EU-USA negotiation was in a holding pattern for a number of years since the USA rejected the Kyoto Protocol and expressed its unwillingness to discuss any alternative architecture. To overcome the political bargain, the EU-USA negotiations had been continued in particular outside the UNFCCC framework. As noted by Bodansky (2010), when the USA re-engaged in the negotiation process the split between the US and EU paled and the shift in the negotiating dynamic became apparent, and the developed-developing country divide moved to centre stage.

Though it was shadowed by the EU-USA negotiation and was not that noticeable, the difference between developing and developed countries on technology transfer was significant in every COP in particular in COP12 in Nairobi. The gulf between the two parties continued into COP13, which took place in December 2007, in Bali, Indonesia. Negotiations on technology transfer were one of the major stumbling blocks and were among the last issues to be resolved (CIEL, 2008). However, the conference managed to adopt the Bali Action Plan (BAP), which identified technology development and transfer as one of the four “building blocks” of a future climate change agreement. COP13 also commissioned the Global Environment Facility (GEF) to develop “Strategic Programme”. Parties in COP14 in Poznan, Poland endorsed the GEF’s program and became the “Poznan Strategic Program on Technology Transfer” (Lovett et al. 2009). The main focus of the program was to scale up the level of investment in technology transfer through existing GEF processes. As noted by Lovett et al. (2009) the Poznan Strategic Program was weak for refashioning or strengthening existing institutions. As the halfway point between Bali and Copenhagen, COP14 made commitments for the next 12 months to continue the negotiating processes to enhance international climate change cooperation under the Bali Roadmap.

In Copenhagen and the period leading up to COP15, the focus of contention around technology transfer was largely on the governance and funding of technology transfer including: (i) Institutional arrangement: the type of organizational structure and power the technology transfer organizations should wield, (ii) Intellectual Property Rights (IPR): whether additional instruments are necessary for Intellectual Property Rights (IPR) or not, (iii) Finance: how much money should be contributed, from what sources, and with what governance arrangements. These are the most common contentious issues in climate technology-transfer agreements (De Coninck et al. 2008).

The 2009 Copenhagen Conference was the fifteenth Conference of the Parties (COP 15) to UNFCCC and the fifth Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (COP/CMP 5). The Conference took place from December 7-19, 2009. About 115 world leaders attended the conference, and more than 40,000 people, representing governments, non-governmental organizations, and intergovernmental organizations were gathered. The role of technology transfer in achieving the stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system has been recognized in the UNFCCC's goals since the convention came into force in 1994 (UNFCCC 1992). In this regard, the UNFCCC requires Parties to promote and cooperate in the development and diffusion, including transfer of technologies that control, reduce, or prevent GHG emissions. The ratification of the UNFCCC has been the grand institutional setting for potential international cooperation on climate change. Technology transfer discussions under the UNFCCC include commitments for technology and financing, particularly flowing from developed to developing countries, as well as potentially facilitating international licensing and patent protection (Coninck et al. 2007).

In Copenhagen the discussions were carried out in two working groups, on the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) and Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA). Technology transfer was debated and negotiated in the long-term action group (LCA) along with mitigation, adaptation, and shared vision. In the LCA group the negotiators were attempting to come up with as much consensus as possible on texts on technology issues. The centre of contentions on technology transfer in Copenhagen focused on the governance of international technology transfer and institutional arrangements for financial resources, and intellectual property rights (IPR).

Despite those efforts, in the 2009 climate conference technology transfer remained as one of the most controversial and unresolved issues. The debates on technology transfer were

affected by incompatible preferences between the developing and developed countries. This chapter of the thesis reviews these preferences and bargains between the two parties on Long-term Cooperative Action and its implications for climate technology transfer to developing countries. Before turning to the analysis of the negotiations carried out in the LCA group the next section provides an overview of the debates in the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).

4.3 IMPASSES OVER POST-KYOTO AGREEMENT

A major criticism of the Copenhagen Conference was the failure to attain reduction commitments and the lack of assurance that the Kyoto Protocol would continue in a second period starting 2013. The Meeting of the Parties to the Kyoto Protocol (CMP 5) in the 2009 Copenhagen Conference began with the issue of further commitments by developed countries to reduce their GHG emission under the Kyoto Protocol (KP). The first commitment period, with a target of 5.2% reduction based on 1990 levels, was to end in 2012. The Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) has worked since 2006 with a mandate to conclude negotiations on the second and subsequent commitment periods of Annex I Parties so as to ensure there would not be a gap between the first and the second commitment periods. Further emission cuts were one of the most important items stalling the talks at the Copenhagen Climate Conference.

Further emission cuts with new obligations on the developing countries has been most contentious in the negotiations, as it relates to the principle of “common but differentiated responsibilities”. The G77/China insisted that based on this agreed principle developing countries should not participate in the Protocol’s call for emissions reductions including the second commitment period under the Protocol. Whereas the developed countries argued that the principle of “common but differentiated responsibilities” needs, at the least, a new approach. They, in particular Japan and Europe, insisted that the present Kyoto Protocol³ should be replaced by a new single agreement that includes the US but that also places new obligations on the developing countries to act on their emissions. This was unacceptable to the developing countries because, in their turn, they insisted that the Berlin Mandate doesn’t require them to participate in any emission cut commitments and obligations. In addition, they had doubts on the effectiveness of the new treaty to place strict and legally binding commitments on the developed countries to cut their emissions, unlike the Kyoto Protocol.

³ Almost all members of the UN Framework Convention on Climate Change are members of this protocol, with the United States as a notable exception.

TABLE 4.1 THE INCOMPATIBLE PREFERENCES OF DEVELOPING AND DEVELOPED COUNTRIES ON EMISSION REDUCTION AND POST-KYOTO AGREEMENTS

Bargaining points	Developed countries (Annex I + USA)	Developing countries (G77+China)
Kyoto Protocol (KP) The second and subsequent commitment periods for greenhouse gas (GHG) emission reduction targets under the Kyoto Protocol	A new agreement should be established that replaces the present Kyoto Protocol. KP should be superseded or made redundant because a comprehensive and ambitious agreement is needed, which is more inclusive than the KP (Developed countries except USA).	The Kyoto Protocol should be maintained, as it was the only reliable basis for emission reductions. The Group reiterated that it rejected attempts by developed countries for another legally binding instrument that would put together the obligations of developed country Parties under the Kyoto Protocol and actions of developing countries.
Conditions for emission reduction commitments	Governments announced emission cut figures before and during COP15 are made in the context of a new, universal, comprehensive and effective international agreement on climate change that is provided that USA and major developing economies also do their part.	The legal commitment of Annex I Parties is under the KP, not dependent on any other Parties. Under the KP, they are to lead in emission reduction, and also in providing financial and technological support. These commitments should be done under no conditions.
Figures on the emission reduction targets	Most Annex I Parties have tabled a 2020 emission reduction target and the range of emission cut pledged is between 16 and 23% of the 1990 levels by 2020. USA 17% of the 2005 levels. The EU has already endorsed a 30% reduction provided other developed countries contribute in comparability and major developing economies also do their part.	The targets for Annex I countries for the second commitment period have to be an aggregate target and should be over 40% reduction by 2020 compared to 1990 levels. Anything less than this will not be true to science and the current pledges by Annex I Parties are inadequate, and if accepted, will put the world on a track for a 3.5- degree temperature increase.
Market-based approaches The use of market-based flexible mechanisms (Emissions Trading, Joint Implementation, Clean Development Mechanism) to meet the reduction targets	Market mechanisms were important to ensure the cost-effectiveness of mitigation, the group said (in particular the EU). It asked for this issue to be included in the agreement.	Addressing climate change through Market-based approaches is purely an economic affair distorting the principle of polluter pays to the one who pays has the right to pollute. The need to provide adequate funding sources to face the challenges of climate change is not a market.
Measuring, reporting and verification (MRV)	The developing countries actions on mitigation should be subjected to the measuring, reporting and verification (MRV) internationally.	The issue of measuring, reporting and verification internationally could affect, national sovereignty and national competence. Therefore, to have one's own oversight was important.
Form of the final agreement	Proposes the adoption of a political agreement.	Rejected attempts to have a political agreement rather wanted to see a legally binding document.

Source: Country submissions and interviews conducted face to face with country delegates on 31 May - 11 June and 2 Aug - 6 Aug 2010 in Bonn, Germany as well as by emails and telephone calls.

The United States for its part had strongly reiterated its rejection of the Kyoto Protocol because of the conditions set in the Byrd-Hagel Resolution. As a result, the talks were deadlocked on whether the Kyoto Protocol would survive and whether there would be a new single agreement. Along with the fate of the Kyoto Protocol, there were many issues surrounding the bottleneck in the negotiations of the emission reduction of developed countries. Table 4.1 reports the major impasses over Post-Kyoto and emission reduction agreements.

As summarized in Table 4.1, the two parties disagreed on almost every major issue of the Kyoto Protocol. Each nation committed and agreed to abide by its domestic climate commitments, whether those are in the form of laws and regulations or multi-year development plans. But domestic political circumstances were not always conducive to action, especially for the USA it was an inappropriate time as the domestic climate legislation, formally called the American Clean Energy and Security Act of 2009 (ACES) was in the hands of the senate. This legislation, which aimed to reduce greenhouse gas and facilitate the transition to a clean energy economy, was approved by the House of Representatives on June 26, 2009 by a vote of 219-212, but was still under consideration in the Senate. Bang et al. (2007) noted that agreement on this legislation would seem to be a prerequisite for extension to an international agreement. As a result, President Obama was not able to offer anything to the conference and other countries responded in kind.

However, during the closing of the COP plenary, twenty-five heads of government and state, 'Friends of the Chair', did manage to agree on the text of what became known as the 'Copenhagen Accord'. The way the "Friends of the Chair" was organized, and the process that led to the creation of the Accord, subsequently created concerns that an "un-transparent and undemocratic" negotiating process characterized it. As a result, some countries namely Bolivia, Cuba, Nicaragua, Venezuela and Sudan opposed the Accord and the COP decided to do no more than "take note" of the Copenhagen Accord.

Even among most of the negotiating groups that agreed on the Accord, there was a common understanding about the imperfection of the Accord, but they supported its adoption in order to turn it into an operational step towards a better future agreement. In reference to this, Papua New Guinea said, "the Accord is not perfect but it is a quick start and begins to build architecture" (Naughton and Hines 2009). The Accord does not mention any figures of the emission reduction that the developed countries were to undertake after 2012 when the first commitment period for emission reductions under the Kyoto Protocol expired, either as an aggregate target or as individual country targets.

4.4 INSTITUTIONAL ARRANGEMENTS FOR ENHANCING CLIMATE TECHNOLOGY TRANSFER

This section outlines the institutional implications for technology transfer of the Copenhagen Agreement and analyses the discussions and eventual agreements on the necessary institutional arrangements. The developing country position on institutional realignments was that existing institutions, in particular those outside the UNFCCC, are not functioning well and market mechanisms are insufficient. Developed countries argued that the G77/China need to ensure proper regulatory environments to create demand for technologies and that they need

to ensure intellectual property protection and enforcement to ensure that companies feel comfortable licensing technology. These are part of attempts for a broader re-framing of climate technology transfer that focuses on market mechanisms, mitigation technologies, and on the flexibility of mechanisms such as the CDM.

Before examining the institutional implications of the Copenhagen conference, it is first worth looking at the nature of existing institutions under the UNFCCC that deal with technology transfer.

- The Conference of the Parties (COP) is highest decision-making authority of the Convention. All countries that are Parties to the Convention are members of the COP, and each has equal status. There are two permanent subsidiary bodies, which support the work of the COP. These are the Subsidiary Body for Scientific and Technological Advice (SBSTA) responsible of providing advice to the COP on scientific, technological and methodological issues. The other is the Subsidiary Body for Implementation (SBI) that oversees the assessment and review of the Convention's implementation. In addition to the two standing subsidiary bodies, the COP can form ad hoc subsidiary bodies to carry out specific tasks. All Parties to the UNFCCC are also members of these ad hoc groups.
- IPCC and GEF, which external to the UNFCCC provide information via scientific reports and operates the Convention's general financing mechanism respectively.
- The Convention also established a Secretariat to provide support to all the institutions of the climate change convention processes.
- The key UNFCCC body for technology transfer is the Expert Group on Technology Transfer (EGTT), which was established with the objective of enhancing implementation of Convention goals on technology transfer (specifically Article 4, paragraph 5 of the convention), including inter alia, by analyzing and identifying ways to facilitate and advance technology transfer activities.

In the run up to Copenhagen and COP 15, most of the debates on technology transfer focused on establishment of new institutions, and/or strengthening and redefining existing institutions as a prerequisite for enhanced action on technology transfer under and outside the UNFCCC.

The positions shown in Table 4.2 are on the basis of broad categorizations: developing and developed nations, otherwise there have been some very minor differences within each group. For instance, major developing countries (the so called BASIC countries: Brazil, South Africa, India and China) are interested more in mitigation technologies, whereas LDC interest lies in adaptation.

TABLE 4.2 THE INCOMPATIBLE PREFERENCES OF DEVELOPING AND DEVELOPED COUNTRIES ON TECHNOLOGY TRANSFER: INSTITUTIONAL ARRANGEMENTS

	G77 + China	Annex I Countries + USA
1	Establishing a new body under the UNFCCC: Establishing an Executive Body (EB) that would function as the main institution under the UNFCCC. One of the EB's tasks would be to develop a global Technology Action Plan to accelerate research and invention.	Maintaining the existing bodies and strengthening the involvement of the World Bank: Technology development and transfer through different channels, including the World Bank and regional development banks. Expressed preference for a sectorial approach to technology. Japan proposed the establishment of sectorial expert committees with participants from the public and private sectors to identify and analyze relevant technologies.
2	Creating a favourable environment for climate technology transfer at the international level but still under the UNFCCC: Establishing supporting Technical Panels that would compile information on policies and measures, intellectual property rights and cooperation and assessment, monitoring and compliance.	Creating favourable environment for climate technology transfer at the national level in developing countries: The UNFCCC should facilitate the creation of an effective domestic environment for innovation and dissemination of environmentally sound technologies in a broader context of mitigation and adaptation strategies.
3	Refashioning the existing governance of finance under the UNFCCC: Establishing a Multilateral Clean Technology Fund (MCTF) under the UNFCCC that would provide technology-related financial support as determined by the Executive Body. The fund would partly act like a venture capital fund, where public investment leveraged private capital for emerging technologies.	Maintaining the existing governance of finance and strengthening involvement of the World Bank: Expressed preference for strengthening existing institutions, including those outside the UNFCCC like the World Bank.
4	Attempted to modify the Expert Group on Technology Transfer (EGTT)	Proposed maintaining the EGTT and continuing its work

Source: Country submissions and interviews conducted face to face with negotiators on 31 May - 11 June and 2 Aug - 6 Aug 2010 in Bonn, Germany as well as by emails and telephone calls

The most noticeable differences between developed countries were on emission targets. For instance, small islands led by Tuvalu proposed a new protocol which would have the advantage of potentially forcing deeper global emission cuts that also required other developing countries to participate in the emission cut commitments and obligations. Tuvalu was immediately supported by other small island states, including Grenada, Trinidad and Tobago and several African states; but 15 countries, including the powerful nations of China, Saudi Arabia and India, opposed it. However, when it comes to technology transfer the split between the countries in each group pales in comparison to the gulf between countries on emission targets and other issues. The issue of technology transfers mostly is a shift of primary axis in the negotiations from EU-US and BASIC-Small Islands to developed-developing countries.

The proposals indicated in Table 4.2 are founded on the major arguments of the two groups. In spite of the strong divisions between the two groups, there were some areas of agreement.

(i) Establishment of Technology Mechanisms to accelerate technology development and transfer in support of adaptation and mitigation that will be guided by a country-driven approach and based on national circumstances and priorities. As shown in Table 4.2, creation of such mechanisms is the result of compromises to developing countries demand for international mechanisms and the developed countries stance on the importance of national actions.

(ii) Creation of a Copenhagen Green Climate Fund as an operating entity of the financial mechanism. However, there were no concrete agreements on the functions of these entities on issues such as the exact structure and mandate of the entities, as well their funding.

(iii) Enhancing environments and capacity building for technology development and diffusion.

(iv) The two groups also reached agreements on one of the major stumbling blocks in the negotiations leading to Copenhagen: establishment of international measurement, reporting and verification (MRV) mechanisms. True to the Accord those actions supported by international finance and technology transfer and capacity building will be subject to international MRV. MRV is one of the issues that placed China and the US in very odd positions. It was when the Chinese premier announced the flexibility of his country for the international MRV that the negotiations returned to life. The final consensus seems to consider demands of both parties despite the lack of clarity regarding the actual implementation mechanisms for MRV.

(v) There was also an understanding, broadly shared among negotiators, that the CDM should continue to exist under a future agreement, even though there was controversy on how precisely it should be reformed and what activities it should cover. There is a general understanding that the CDM does not deliver the necessary climate technology transfer for all developing countries including: imbalanced regional distribution, high transaction costs, slow registration processes, etc. (Schneider et al. 2008; Rong 2010).

(vi) The two parties also had similar proposals on establishing and strengthening national and regional centres of technological innovation and networks. They agreed to develop a technology action plan that would include establishment of national and regional technology excellence centres. The plan would reinforce north-south, south-south and triangular cooperation, including joint research and development. The USA proposed a new structure referred to as 'Hub and Spokes' that would compile information on technologies and develop tools and models to assist technology needs assessments, technology road mapping and policy design relating to all stages of the innovation cycle.

4.5 INTELLECTUAL PROPERTY RIGHTS (IPR)

In the Copenhagen Conference, developed countries emphasized the role current IPR frameworks have for encouraging and rewarding innovation and creating a predictable investment environment whereas developing countries pushed for the improvement of the current IPR framework. The argument is based on the fact that IPR in the area of climate technologies need attention, though they do not deny its contribution for innovation. This position was also substantiated by one of the Brazilian delegates who said “IPR encourages innovation in particular in the private sector and no one can deny that” he added “however, the current IPR regimes seriously affect the diffusion of climate scientific knowledge and technology” (personal communication, June 07, 2010 in Bonn). In the complex process of climate technology transfer negotiations, the issue of Intellectual Property Rights (IPR) has proven to be one of the most contentious debates (De Coninck 2008).

Country submissions of developing countries have considered IPR as a potential barrier to technology transfer. By contrast, in developed countries submissions, IPR is considered as an incentive for further technology development. NGO's and business proposals on IPR for the Copenhagen Conference mirror the debate between developing and developed countries. Most NGO's have stated as their position that IPR is one of the obstacles that must be addressed in a systemic and crosscutting manner to promote the transfer of technology (Meyer et al. 2009).

Business representatives, in turn, advocate establishment of appropriate institutional frameworks and strong protection of IPR. In particular, the United States Chamber of Commerce pushed for strong protection of intellectual property rights throughout the negotiations (U.S. Chamber of Commerce 2009).

To address the crucially important issue of IPR, the LCA non-paper considered five distinct options:

- (i) Technology development, diffusion and transfer [shall] be promoted by operating the intellectual property regime in a balanced manner.
- (ii) Countries could take a range of measures to ‘address adaptation or mitigation of climate change’ – including the use of compulsory licensing, the creation of a patent pool, and the sharing of publicly developed technology.
- (iii) Least developed countries vulnerable to climate change could exclude environmentally sound technologies to adapt to and mitigate climate change.
- (iv) The Executive Body on Technology should establish a committee or an advisory panel or designate some other body to proactively address patents and related intellectual property

issues to ensure both increased innovation and access for both mitigation technologies and adaptation technologies.

(v) Parties may compulsorily license specific technologies for the purpose of mitigation and adaptation to climate change.

TABLE 4.3 THE INCOMPATIBLE PREFERENCES OF DEVELOPING AND DEVELOPED COUNTRIES ON TECHNOLOGY TRANSFER: INTELLECTUAL PROPERTY RIGHTS (IPR)

	G77 + China	Annex I Countries + USA
1	IPR is a potential obstacle to climate technology transfer and hence some form of action needs to be taken.	IPR is an incentive for further technology development, rather than a potential barrier to Technology Transfer
2	Proposed the use of compulsory licensing and exemption where IPR is a barrier to the diffusion of technologies in developing countries.	IPR is developed and held privately in most countries. Parties should consider ways of improving the environment for technology diffusion.
3	Identification and removal of all barriers to access technologies at the most affordable cost and appropriate treatment of intellectual property rights including exclusion of patents on climate related technologies to developing countries Parties.	The protection by countries of intellectual property right is an essential component of an overall strategy to promote technology innovation, diffusion and transfer
4	The existing IPR system does not match the increasing needs of accelerating development, transfer, and deployment (D&T&D) of environmentally sound technologies (ESTs) to meet challenges of climate change. An innovative IPR sharing arrangement shall be developed for joint development of ESTs.	Protection of IPRs is crucial as they and their associated profits contribute to recoup research and development investments, provide strong incentives for further technology development and transfer, and also create sources of business competitiveness.
5	Specific regulatory arrangement to curb negative effects of monopoly powers of environmentally sound technologies shall be put in place.	The group recognizes the benefit of IP protection, which supports country ownership and encourages the implementation of locally defined development strategies.

Source: Country submissions and interviews conducted face to face with country delegates on 31 May - 11 Jun and 2 Aug - 6 Aug 2010 in Bonn, Germany as well as by emails and telephone calls

The G77 plus China group supported such options vigorously, whereas developed countries led by the United States and Australia, resisted inclusion of such options in any agreement. As a result, no agreement was reached and surprisingly the Copenhagen Accord did not contain any text on IPR.

4.6 FINANCIAL ASSISTANCE AND RESOURCE MOBILIZATION

The COP15 negotiations on finance were relatively successful and the issue of finance was treated in a number of places in the Accord. The key messages, however, were in three consecutive paragraphs, (i) creating a Copenhagen Green Climate Fund, (ii) establishing a High-level Panel on potential sources of revenue, and (iii) create a “collective commitment” for developed countries to provide “new and additional” resources.

The finance discussion was centred on issues such as how much money, from what sources, and with what governance arrangements? The main tension behind these core issues was examining Regulatory Approaches versus Market Based Methods for climate technology transfer. Developed countries emphasized the role of the market and the need for states to create enabling regulatory environments. Their argument was based on the success story of market instruments for technology transfer in other conventions, for example technology transfer for the Ozone Layer in the Montreal Protocol. However, some academics argue that there are fundamental differences between climate friendly technologies and other technologies, and the general trend from regulatory approaches to market based methods or from public sector to private sector finance for channeling technology is a concern for the transfer of climate friendly technologies (Andresen et al. 2007). Therefore, the success story of market-based approaches for the transfer of some technologies cannot be easily translated to climate friendly technologies.

In agreement with the Accord's paragraph 10, US\$30 billion in "fast start" money for the period 2010-2012 would be provided, balanced between adaptation and mitigation and long-term finance of a further US\$100 billion a year and by 2020; and it would be mobilized from all sources (public and private, bilateral and multilateral).

On the collective commitment paragraph, and the amount of the fund pledged, there were at least four major concerns:

- (i) Since the Copenhagen Accord does not bind Contracting Parties for the work to be continued, the basis for making operational the financing provisions in the text is uncertain. In addition, it was not backed up by an acceptable, concrete scheme of how these funds are to be raised.
- (ii) The two groups – developing and developed countries - conceptualized the agreed funding differently. Developed countries saw financial assistance, in essence, as part of an implicit quick-fix linked to developing country mitigation commitments whereas developing countries, in contrast, saw it as payment of the "carbon debt" that they believe that developed countries owe for their historical emissions (Bodansky 2010).
- (iii) Another ambiguity would be whether this pledged money is new and additional or if it is just part of existing funding, such as financing from Official Development Assistance (ODA). This might end up with a different interpretation and eventual setbacks from promises; and the enthusiasm to contribute to such a new and additional fund could fade through time.
- (iv) The pledged amount may fall short of estimated needs. From what has been estimated by different groups the pledged amount is relatively small. In this regard, the UNFCCC

estimated yearly technology transfer financing to be an estimate of additional investment flows to developing countries, ranging from \$95-150 billion (UNFCCC 2009). In that sense, the pledged US\$100 billion falls short of the UNFCCC estimation too.

Despite disparities in the positions of the two parties as shown on Table 4.4, the stand of the G77 plus China on financing received moderate support from developed countries. There was a general consensus by both sides that climate technology transfer at scale requires public funds in order to leverage private financing, and states agreed on the need for substantial new funding to help developing countries mitigate and adapt to climate change. However, what this leveraging of private finance through public finance precisely entails is a controversial issue.

The finance issue was informally discussed among the main players shortly before the Copenhagen Conference, meaning outside the UNFCCC framework. The discussion was mainly between Nicolas Sarkozy, Meles Zienawi, and Barrack Obama. The Africa Union chief negotiator, the late Ethiopia's Prime Minister, Meles Zienawi, acknowledged these discussions without giving any detail about the deal made (acknowledgement of these meetings by the Prime Minister was disclosed in Copenhagen to a group of Ethiopians on December 20, 2009 in the Amharic language).

Though moderate agreement was reached on the pledges of money, developed countries put some conditions for developing countries to be eligible for the financial assistance. The Group said that developing countries have been promised assistance if they undertake mitigation actions, provided they subject themselves to measurement, reporting and verification. The group also associated the financial assistance with acceptance of the Copenhagen Accord. In this regard, Ed Milliband, the former UK Energy and Climate Change Minister, was straight forward about linking funding of developing countries with accepting the Accord. The US also wanted an arrangement through which Parties can associate with the Accord. It said there are funds in the Accord, and it is open to any Party that is interested (Eilperin 2010, April 09). This implies that Parties that do not register their endorsement of the Accord would not be eligible for funding. The G77 plus China challenged these conditions by asking (Naughton and Hines 2009, Dec.08; Watts 2009, Dec.19): What if these actions are found by some undefined, inadequate standards? What about the promised financing then? The Group also asked when all of these are going to be implemented, even if it is assumed that all the Parties would also sign and ratify whatever new treaty is projected to be negotiated post-Copenhagen.

TABLE 4.4 THE INCOMPATIBLE PREFERENCES OF DEVELOPING AND DEVELOPED COUNTRIES ON TECHNOLOGY TRANSFER: FINANCIAL ASSISTANCE AND RESOURCE MOBILIZATION

	G77 + China	Annex I Countries + USA
1	Developed country Parties shall take substantive action to provide financial resources mainly from their public finance on grant and concessional basis for developing country Parties. A supplementary role can be played by other sources of finance like the private sector and global carbon markets. Nonetheless, the major source of funding will be the public sector.	The international financial architecture has to catalyse various sources (private/public) and mechanisms (e.g. carbon market, innovative instruments) both at national and international level. Private finance will be the bulk of the scaled-up finance, particularly for mitigation, and will play a major role in driving economic and technological changes. Nevertheless, public funding will remain subsidiary for technology innovation, diffusion and transfer.
2	Developed countries' parties and other developed parties shall provide substantial, predictable and public funding. The funding scale shall be USD 400 billion per year but some countries like Bolivia and China called for 0.5-1% of the annual GNP of Annex I Parties.	Given that the private sector is responsible for 86% of global investment and financial flows it is clear that it will be the principal mechanism for technology diffusion. Improving an enabling environment for the private sector is the key for encouraging the involvement of more business, which will lead to further promotion of Technology Transfer. Commercialization in various forms such as product exports, joint ventures, and licensing constitute also valuable means.
3	Developed countries' Parties shall provide substantial, predictable and public funding additional and different from ODA to meet the agreed full costs and/or incremental costs incurred by developing countries' Parties.	Domestic and international private investment, public sector financing, multilateral mechanisms such as the new Climate Investment Funds at the World Bank, and carbon markets.
4	The money needed by developing countries is to address the climate impacts that have been caused by the historical emission of developed countries. The financial pledges are based on historical responsibility and polluters pay principle.	Developing countries were promised assistance if they undertake mitigation actions, provided they subject themselves to measurement, reporting and verification.
5	Copenhagen Green Climate Fund (GCF) as an operating entity of the UNFCCC's financial mechanism should be established.	The existed institutions for channeling funds for climate technology transfer should be maintained.

Source: Country submissions and interviews conducted face to face with country delegates on 31 May - 11 June and 2 Aug - 6 Aug 2010 in Bonn, Germany as well as by emails and telephone calls.

Developing country negotiators reiterated the fact that financial assistance was not a priority in the Copenhagen bargaining. In this regard president Lula of Brazil said (Susan Watts 2009, Dec. 19), "Some leaders think that money will solve the problem. Money is important to address the climate challenge, but developed countries should not see this as doing developing countries a favour. Developing countries are not begging for money and this was not a bargain between those who have money and those who do not. The money needed by developing countries is to address the climate impacts that have been caused by the historical emission of developed countries". Mr Lula added, "Brazil did not come here to beg any one. We don't need foreign money for our targets - we can meet them with our own resources." He even surprised the parties by announcing the possibility that Brazil will contribute economically toward climate change measures in needy countries.

The arrangement for the UNFCCC financial mechanism got moderate support from both sides. The Copenhagen Accord called for the establishment of a Copenhagen Green Climate Fund (GCF) as an operating entity of the UNFCCC's financial mechanism, as well as

a High Level Panel to consider potential sources of revenue to meet the \$100 billion per year goal. Meanwhile the Accord did not exclude the idea of the developed countries either; it included the proposal in Accord paragraph eight (8) stating that a "Significant portion of international funding should flow through the GEF". In COP14 in 2008, the Poznań Strategic Programme reported the major gaps in GEF support for technology transfer; it described the entities' engagement with the private sector as 'haphazard' and highlighted the entities weak national communications and lack of knowledge management on technology transfer activities (Lovett et. al. 2009). It is not clear whether these gaps were taken into consideration when it was decided that the GEF would continue as a major operating entity to manage the "significant portion" of international funding.

4.7 THE CLIMATE LOSERS CLUB: WHO LOST IN COPENHAGEN?

The 2009 Copenhagen Conference put the whole world in the climate losers club, because the costs of doing little or nothing in climate change would be even bigger in the long run. Stern (2006 and 2007) estimated that the price of failing to act will be equivalent to losing at least 5% of global GDP each year. Inaction will make the marginal abatement cost curve of a country higher and the associated need for adaptation will increase the cost of, and potential for, economic development (Keller 2004; Agrawala and Fankhauser 2008; Biswas et al. 2001; IPCC 2007).

The "winners" indicated on Table 4.5 will eventually be swamped by these costs and resulting destabilization. Therefore, from one perspective, the Copenhagen Conference did not produce any winners, as there was no any change from the old path.

The international climate negotiations under the UNFCCC represent the type of institutions that historical institutionalism characterizes as entrenched and resistant to reform (Katznelson and Weingast 2005). Table 4.5 reports winners and losers as if the bargaining in Copenhagen was a zero game – as if one party loses but the other party wins. However, in Copenhagen there was no bold expression of political will that would have radically change the political landscape and trajectory of the international climate regime. In this respect the Keohane (1984) regime formation theory can be applied here, because states have assumed the opportunity costs of belonging to the concrete agreement outweigh an alternative course of behaviour, and as a result they were not interested in establishing a regime. There was a last minute compromise but that did not include any binding verifiable, and internationally enforceable agreement. It helped only to avoid total disarray. Equally there was no concrete agreement for technology transfer.

TABLE 4.5 THE CONSEQUENCE OF THE FINAL AGREEMENTS ON THE INCOMPATIBLE PREFERENCES OF DEVELOPING AND DEVELOPED COUNTRIES

	G77-China	China	Annex I - USA	USA
On Measuring, reporting and verification (MRV)	The developed countries demanded MRV mainly from the BRICS countries. However, Brazil, India and South Africa were flexible to the demand.	Loser: It had to make a concession on the verification of its actions.	Winner: obtains the verification of developing countries actions, esp. those of China, through international consultations and analysis.	Winner: obtains the verification of developing countries actions, esp. those of China, through international consultations and analysis.
On the future of KP	Loser: Their fight for ambitious climate-agreement goals was unsuccessful. The Accord makes no reference to a future legally binding instrument at any point in time.	Winner: The accord sets no additional obligations compared to what it plans to do domestically.	Loser: The Accord does not take a decision on the future of the Kyoto Protocol. So hypothetically KP Parties find themselves stuck in the KP.	Winner: The accord sets no additional obligations compared to what it plans to do domestically.
Financial assistance	Winners: Agreements were reached to provide new and additional quick -start resources.	It is not clear if China wants the financial assistance of the developed countries.	Loser: Could not position the private sector as a principal mechanism for financial flows. Their contribution is much more than the USA's to fast start finance.	Its contribution is much less (1/3) than the Japanese and the EU to fast start finance.
Financial ⁴ assistance for climate technology transfer	Loser: the agreement does not show a clear linkage between the technology mechanism and financial arrangements.		Winner: no agreement for additional fund for the activities undertaken within the technology mechanism.	Winner: no agreement for additional fund for the activities undertaken within the technology mechanism.
Institutional arrangements for climate technology transfer	Winners: agreements have been reached to rekindle institutions under the UNFCCC.	Winners: agreements have been reached to rekindle institutions under the UNFCCC.	Losers: maintaining existing institutional systems was not accepted.	Losers: maintaining existing institutional systems was not accepted.
Performance Assessment and Monitoring for technology transfer	Losers: there was no concession on the monitoring and assessment mechanisms for climate technology transfer including range, scale and effectiveness.	Loser: there was no concession on the monitoring and assessment mechanisms for climate technology transfer including range, scale and effectiveness.	Winners: They will not make a concession on the verification of their actions on climate technology transfer.	Winners: It will not make a concession on the verification of its actions on technology transfer.
IPR	Loser: the agreement does not contain any text on IPR as there was no agreement to change the current IPR framework.	Winner: happy with the current IPR framework.	Winner: the agreement sets no additional obligations on IPR.	Winner: the agreement sets no additional obligations on IPR.
Technology in general	Loser: the Accord was very thin on technology and the agreement was not concrete enough for technology transfer.	Loser: the Accord was very thin on technology and the agreement was not concrete enough for technology transfer.	Winner: technology transfer was very thin in their submissions and the agreement didn't set major additional obligations .	Winner: technology transfer was very thin in its submissions and the agreement didn't set major additional obligations.

Lack of information about the other Parties' objections and commitments were revealed during the conference; and fear of cheating, and questions concerning domestic interest were played out. In this regard, the AU chief negotiator, Meles Zienawi, when explaining one

⁴ In Copenhagen, developing countries wanted to see a clear linkage between the technology mechanism and financial arrangements under the COP technology transfer agreements to ensure that proposals on technology transfer would receive financing.

of the reasons for his success in the finance negotiation said “we were successful in finance negotiation partly because we did not reveal to anyone our bargaining figures until we discussed them with the relevant parties” (Ethiopia Television Broadcasting Service Dec. 20, 2010). That could be a reason why President Barack Obama and other developed country presidents and premiers were curious to know what financial bargains Zienawi had for Copenhagen; and which they discussed with him shortly before the conference.

This research revealed that most of the delegates interviewed to solicit further information on the Copenhagen negotiations were politically endowed with extremely suspicious approaches. Such a response was not surprising because the climate change negotiations under the UNFCCC were already confined within a politically charged atmosphere, which was intensified at the Copenhagen Conference. When explaining his suspicion about this research, an Indonesian delegate said “we have lost because of asymmetrical information flow, therefore, we have to be careful with our words, in particular outside the UNFCCC negotiation halls” (personal communication, Aug. 07, 2010 in Bonn). A Belgian delegate said: “it is not easy to say something on technology transfer as we do not have a clear picture of the kind of technological mechanisms that can satisfy the demand of the other party” (personal communication, July 13, 2010).

In Copenhagen, domestic interests dominated the negotiations, all parties wanted to be a winner, nobody wanted to lose and compromise their position. Every one focused on the benefits and costs at stake in the negotiation. To an extent these potential benefits and costs caused the Copenhagen Conference and its aftermath to be a politically charged atmosphere. In an environment where it was not possible to create a “win-win” situation, some countries would seem to be losers, and other winners, of the bargains. Therefore, it is pertinent to ask, who won and who lost in Copenhagen? Table 4.5 reports the winners and losers of the bargaining.

4.8 CONCLUSION

The Copenhagen Conference outcome confirmed the validity of the very first decision of the first Conference of the Parties of the UNFCCC, the Berlin Mandate, which led to a dichotomy between developed and developing countries. These deep divisions characterized the Conference, a lack of information about the other Parties’ objections and commitments was revealed and domestic interests dominated. The results of the conference were more limited than many people had hoped for, and are less than some people may have expected. The discussions on technology transfer have been marked by the incompatible preferences between developed and developing countries.

Causes for the deep divisions between the global North and South countries, and the reasons incompatible preferences persist, rest not in the absence of shared norms, the importance of combating climate change, but in the historical contingency implicit in the principle of 'differentiated responsibilities' that led to the Byrd-Hagel resolution, which in turn effectively paralyzed the Kyoto Protocol and took the climate bargaining process under the UNFCCC into apparently never ending circles. In terms of what transpired at Copenhagen and subsequent meetings, the differentiated responsibilities principle has been the major sticking point. The Berlin Mandate acted as an anchor, preventing real progress in the Copenhagen international climate negotiations. The developed countries insisted that the post-2012 regime should address the emissions of major developing countries, whereas the developing countries were negotiating on the basis of historical responsibility, capacity to respond, development needs and the polluters pay principle. These divergent foci and approaches of the parties led the conference bargaining process in circles and ended up in a political declaration, the Copenhagen Accord, rather than a legally binding agreement.

Asymmetry in parties' interests and demands did not leave room for an ambitious and a legally binding agreement. As a result, climate technology transfer remained as one of the most conflicted areas and an unresolved issue. It was noted that the issue of climate technology transfer was pushed mainly by the G77 plus China group, whereas developed countries remained reactive and defensive. The issue of IPR appears to be a deadlocked negotiation agenda, and it was not possible to find common ground; as a result, the Copenhagen Accord does not contain any text on IPR. Analytical studies on the relationship between IPR and the transfer of climate-related technologies would be useful to bring the negotiating process on IPR from its deep freeze and overcome the apparent differences.

In Copenhagen there were incremental adjustments on climate technology transfer institutions, but still, divergent and often conflicting preferences persisted in the establishment of these institutions because changes of direction were constrained by the increasing returns and positive feedback that resulted from the first-generation decision i.e. the principle of 'differentiated responsibilities'. In the words of historical institutionalists, the change is path dependent, and its end result is unpredictable. The incremental changes achieved were mainly on institutional arrangements for climate technology that include establishment of a Technology Mechanism, a Copenhagen Green Climate Fund, and a High Level Panel. The effectiveness of these institutions depends on their structure and mandate, openness to non-state actors, and the energy, funds and skills available to exercise leadership; however, wording of the Accord is ambiguous on these issues and on the structure of the envisaged institutions in general.

As a result, the challenges of having an independent institute versus the focus on existing institutions may continue. The negotiators have also reached some kind of agreements (though it may be the lowest common denominator) on collective financing. Collective commitments by developed countries to provide new and additional quick-start financial resources have been agreed. However, here, a serious concern is that there is no guarantee that these are new and additional resources and there is lack of clarity on what happens next, i.e. to make it a legally binding treaty. One of the Philippines' delegates, Andreev Sano, in Bonn on June 10, 2010, assessed this concern and said, "The promises made in Copenhagen regarding funding have not been translated into legal binding agreements yet." The agreements are, therefore, more valuable if they can bind the parties more effectively.

In summary, the debates in Copenhagen were neither about the significance of moving beyond language to concrete consideration of the problems and their potential solutions, nor on the importance of new technology in solving the climate problem per se; but rather about what institutions are for moving up the international negotiations on climate technology transfer. Moreover, the Accord doesn't bind Contracting Parties for the work to be continued under the UNFCCC.

However, the ad hoc adjustments, as well as the split observed among the G77/China group, and in particular the divide between BASIC and Small Islands, could herald the beginning of a process of blurring the developed/developing countries distinction. Perhaps the time has come for innovative proposals for future international climate-policy architecture, not for incremental adjustments to the old pathway. The incremental changes on climate technology transfer institutions might serve as incentives to mobilize coalitions behind the need for changes on the major sticking point of the international climate bargaining: the principle of 'differentiated responsibilities'.

A change on the first generation decision could usher in profound institutional transformation in the realms of international climate technology transfer.

What are the implications of these kinds of incremental changes to national level climate technology transfer policies and strategies; and to effectiveness of climate technology transfer at the firm level in particular, in those countries that need those climate technologies to both avoid locking in high carbon infrastructure and to achieve low carbon development? How are the alliances and groups of parties in the Copenhagen conference translated into practice at the national and local level climate technology cooperation? The next two chapters attempt to answer these questions. Chapter 5 investigates the potential and

relevance of international cooperation for climate technology transfer for informing national climate smart development pathways, whereas Chapter 6 examines the effectiveness of international climate technology transfer at the firm level by making a comparison of different modes of technological cooperation.

CHAPTER 5 RATIONALIZATION OF SOUTH-SOUTH COOPERATION FOR CLIMATE TECHNOLOGY TRANSFER

5.1 INTRODUCTION

5.1.1 BACKGROUND

Chapter 5 investigates the potential, characteristics, and relevance of the new technology transfer paradigm, South-South cooperation, for international climate technology transfer. The evidence for this part of the thesis on the South-South climate technology transfer (SSCT) was provided using the case of Ethiopia.

The evidence clearly indicates that the technological cooperation of least developing countries (LDCs), such as Ethiopia, with developed countries is diminishing and is being overtaken by cooperation among the global south. However, the research concluded that growing South-South climate technology transfer (SSCT) is not an alternative to North-South climate technology transfer (NSCTT), rather it is important to complement North-South cooperation in order to promote the flow of technology to developing countries.

The North-South divide has been present since the UNFCCC came into force in 1994, but Chapter 4 concluded that the divide showed signs of blurring in the Copenhagen Conference due to a dynamic of Southern fragmentation in which major developing and least developed countries assumed markedly different positions. More specifically, the recognition and increasing self-organization of major developing economies in the BASIC group (Brazil, South Africa, India and China) as a separate body of negotiation, has brought a new fragmentation process to the South. Rapid economic productivity and energy use of the major developing countries, which is coupled with increased greenhouse gas emissions over the last two decades, is the cause for emergence of asymmetric interest and fragmentation among developing countries.

On the other side of the equation, differences in economic advancement and technological sophistication among developing countries, has enabled the flow of technology from one developing country to another through south-south cooperation emphasizing the role of developing countries as sources of technology, and not only as recipients of international technological innovations.

The emerging of several developing countries as leading manufacturers and developers of low carbon technologies, and flow of technologies between developing countries, has challenged the traditional characterization of developed-developing, North-South transfer as the only form of climate technology transfer (Brewer 2008). The North-

South technological gap historically characterizes technology ownership (Missbach 1999) with developed countries having a technological advantage.

In least developing countries, such as Ethiopia, technological cooperation with other developing countries has been increasing. However, whether South-South climate technology transfer (SSCTT) is an alternative to North-South climate technology transfer (NSCTT) or not, has been a point of discussion among academicians and practitioners. South-South cooperation (SSC) has experienced successes and failures, challenges and opportunities, which are linked to both the international climate regime and national policies.

The growth of Ethiopian climate technologies imports is one of the fastest in the world. Ethiopia is one of the few developing countries¹, which responding to a voluntary provision of the not-legally binding Copenhagen Accord, planned to carry out mitigation actions to become a carbon neutral country by 2020. This self-commitment signals that changes have occurred to the point where the previous and most fiercely defended Southern consensus has been given up by some developing countries. Since the first negotiations for a climate change framework convention in the early 1990s, the South has united under two unalterable key bargaining positions: developing countries will not accept responsibility for climate mitigation, and thus will not formally commit to Greenhouse gas emissions reductions; and developed countries are responsible for financing the adaptation of the most vulnerable countries.

SIGNIFICANCE OF THE CHAPTER AND RESEARCH QUESTIONS

The central objective of this chapter of the thesis is to investigate whether and how SSCTT, as opposed to NSCTT, can improve transfer of climate technologies. It attempts to advance the understanding and rationalization of SSCTT at the national level taking Ethiopia as a case study. It emphasizes the role of developing countries, in particular emerging economies, as sources and not only as recipients, of international technology innovations. Despite wide recognition of the economic advancement and technological sophistication of developing countries, these changes in relation to international technology flow have not received sufficient attention in academic research and no coherent international policies under the UNFCCC have yet been formulated. The chapter uses climate technology transfer in its broader conceptualization: the international transfer of environmentally friendly technology as embodied in green consumption goods.

The contribution of this chapter to the thesis is twofold: 1) the chapter provides insights into the capacity and potential of SSCTT versus NSCTT, and on involving dominant national policies in developing countries for promoting climate technology transfer through the

¹ By end of 2010 the other developing countries who made similar announcements were the Maldives and Costa Rica.

analysis of Ethiopian government preferences and a search for a model for achieving low-carbon climate resilient national socio-economic development aspirations, 2) based on the results of the analysis of the nature of collaboration between developing countries for promoting climate technology transfer at the national level, the chapter provides the opportunity to reach a better understanding the interconnections and synergies between the local and international levels of technology transfer to fill the knowledge gap in climate technology transfer with empirical evidence.

This part of the PHD study is guided by the following research question:

What is the nature of collaboration between developing countries for promoting climate technology transfer at the national level vis-à-vis the North-South technology transfer?

Based on this main question the specific research sub-questions are:

- i) What is the potential of South-South cooperation for the transfer of climate technology transfer compared to North-South technology transfer?
- ii) What are the motivational factors for the transfer of climate technology from one developing country to another?
- iii) What are the characteristics of South-South technology transfer compared to North-South technology transfer?

5.1.2 METHODOLOGY

The data collection methods used in this part of the thesis were questionnaires, interviews, and focus group discussions. Initial assessment was conducted between October 8 to December 10, 2010 on the status of climate technology transfer in Ethiopia by telephone and email with relevant public agencies and non-state actors. This was followed by three months (from February 07, 2011 to April 27, 2011) fieldwork in Ethiopia to distribute questionnaires and conduct interviews.

Questionnaires were developed in Amharic, the Ethiopian official language, but were also translated and administered into English in order to adapt to the language needs of expatriates. The questionnaires were pilot-tested with six selected respondents and revised to eliminate ambiguity in some of the terminology, adjust the political sensitivity of some questions, and ensure confidentiality of information. After the pilot-testing phase, the questionnaires were distributed in person to eighty-six participants. Most of the respondents required an in-person follow-up meeting to further explain the research study, or to provide assistance with the survey; and some of them were unwilling to comment on public policies.

Private companies, in particular, showed less interest in responding to questions that pertained to their internal financial, logistical, and human capital performances. Sixty-six of the participants returned a completed or semi completed questionnaire, and follow up interviews were conducted with twenty-five of them. The participants include higher political figures (both from the governing and opposition parties), researchers, business people, investors and expatriates.

Focus group discussions were held on April 10, 15 and 22 with a group size of 9, 8, and 10 respectively to explore the meanings of some of the survey findings. The participants for the focus group discussion were selected on the basis of their opinions in the questionnaire. Those who had a range of views came together and discussed on pre-identified topics.

Secondary data, mainly from the Central Statistical Agency of Ethiopia, National Bank of Ethiopia, Ethiopia Investment Authority, Ethiopia Ministry of Capacity Building, Environmental Protection Authority of Ethiopia and Ministry of Commerce and Industry were collected to analyze trends in investments, exports and imports, and to study technological cooperation over a long period of time.

The data collected and analyzed before the field trip (October 8 to December 10) enabled design of the primary data collection to be very specific and targeted. The data analysis was conducted in an on-going iterative process, in which data was continuously collected and analyzed almost simultaneously in order to inform the next stage of the data-gathering process.

The theoretical underpinning for this chapter assesses the potential and relevance of south-south cooperation for climate technology transfer (SSCTT) from two main perspectives. Firstly, the dependency school of thought theorizes national development pathways in relation to international regimes and views south-south technology transfer (SSTT) as technology transfer between peripherals in an horizontal and equal interaction. Secondly, and in contrast, the realist school of thought argues that SSTT is essentially subject to the same dynamics and analytical tools as north-south technology transfer (NSTT). Another theoretical approach that can be used to explain the nature of cooperation modalities for transfer of technology, is the intermediate technology school of thought (IT) promoted by Schumacher and his associates. IT views the SSC as an approach to technology transfer between countries, which share similar histories, culture, and social structure, and thus have a better mutual understanding of their absorption capacity, markets, financial and social situations (Kaplinsky 2009). Unlike the two major schools of thought, IT promotes both north-south and south-south cooperation for technology transfer. This chapter, however, employs

the two major theories (the dependency and the realist school of thought) as methodological instruments to investigate whether and how SSTT, as opposed to NSTT, can improve transfer of climate technologies.

The remainder of this chapter is organized as follows: the next section evaluates the paradigms of south-south climate technology transfer using the overarching theories, and assesses the prominent feature of recent trends of climate technology transfer through the south-south cooperation. This is followed by a section focused on assessing the potential of south-south cooperation for effective climate technology transfer. Sections 4 and 5 analyze the motivations and characteristics of south-south climate technology transfer. The last section (Section 6) concludes with a discussion on the rationalization of south-south cooperation for climate technology transfer.

5.2 LOOKING AT THE EVOLUTION OF SOUTH-SOUTH CLIMATE TECHNOLOGY TRANSFER THROUGH THE LENS OF DEVELOPMENT THEORIES

This chapter of the thesis draws on development theories to examine the nature of collaboration between developing countries for promoting climate technology transfer at the national level vis-à-vis North-South technology transfer. South-south cooperation (SSC) is a source of self-reliance for dependency theorists, but it is a political strategy for exploitation for the realist school of thought.

The surge in academic work on climate technology transfer associated with developments in international climate politics has made the dependency school of thought relevant once again. Therefore, a reconsideration of dependency theory here also seems to be appropriate. The origins of the dependency theory central principle - center-periphery relations- are technological and determined by the international division of labor². They have been promoting SSTT with the aim of enhancing self-reliance and international solidarity but at the same time, technical processes and objects guide it.

The growing innovation capability of climate technologies in emerging economies, and the increasing technological gap among the global south, challenges the potential for dependency theory to understand the SSTT as an alternative to the NSTT. The intermediate technology school of thought (IT) considered these challenges and promoted SSC not as alternative to NSC, but as complementary to NSC and a framework under which technology is transferred among the developing countries. Schumacher and his associates, who believe that technology is ideologically neutral, argues that so long as technology is small-scale,

² In other words, the center produces manufactured goods for itself and the periphery; and the periphery produces commodities mainly for the center, while maintaining a relatively big subsistence system.

decentralized, labor-intensive, energy-efficient, environmentally sound, and locally controlled, it doesn't matter whether the transferor is the global North or the South (Todaro 2003). Many of the ideas integral to intermediate technology, which were described in Schumacher's influential work, "Small is Beautiful", can now be found in the characteristics of climate technologies³.

Advocators of the south-south collaboration (SSC) mode of climate technology transfer, such as the dependency theorists, put the following reasons for promoting SSC for climate technology transfer at the core of their arguments:

- i). The understanding of common developmental and climate challenges among the global South made SSC the appropriate mechanism for a better climate technology transfers.
- ii). Environmental technologies such as cooking stoves could be better advanced in southern countries, since northern countries no longer face issues such as indoor pollution – and if they once had the technology, it has now become obsolete, or the institutional memory has been lost.
- iii). SSC could also create a wide range of trade partners for climate technology and that in turn might reduce market uncertainties.
- iv). The increment in the share of world trade could provide more collective bargaining capacities for the south.
- v) Technologies available in developing countries are perceived by many to be more suitable to the needs and requirements of the South (Mahmoud 2007). They also believe that the manpower required for these technologies is available in the south and more cost-effective than alternatives from the North (Mahmoud 2007).

On the other hand, the realist school of thought views SSC as a political strategy employed by regional powers (i.e. BICS: Brazil, India, China, and South-Africa,) to have weaker states like Ethiopia under their control, thereby elevating their influence in the international arena (Schweller 1997). Realist scholars have conceived states as homogenous actors in an endless process of power struggle for survival and domination. Consequently, from the realist perspective, real cooperation among states is unlikely and SSC is a strategy used by the dominant emerging south states to secure power (Mundy 2007). SSC, as the realist school of thought argued, is promoted by regional hegemonic powers (BICS) to consolidate their dominance and influence and it would be effective as long as it doesn't diminish their power (Karns & Mingst 2004; Woods 2001).

Though the evolution of south-south climate technology transfer is not well recognized in the international climate discussion, it is an interesting phenomenon. Growth of the

³ Characteristics of climate technologies are described in Chapter 1 of this thesis.

emerging economies in climate technologies and other areas creates leader nations within the global south countries and creates a technology gap between them. The technology gap between the global south and specialization in different climate technologies could prompt technology transfer and utilization of complementarities between developing countries and direct cooperation between larger developing countries and other countries in the South (Yu 2009).

The growing innovation capability of climate technologies in emerging economies and the increasing technological gap among the global south challenges the dependency theory thinkers understanding of SSTT as an alternative to NSTT.

The following sections assess the potential and relevance of south-south cooperation for climate technology transfer (SSCTT) from the perspectives of dependency theorists and the realist school of thought.

5.3 GAUGING THE POTENTIAL OF SOUTH-SOUTH COOPERATION FOR EFFECTIVE CLIMATE TECHNOLOGY TRANSFER

The ever-strengthening presence of emerging economics such as China, India and Turkey in Ethiopia has considerably changed the industrial landscape of the country. In 2010, more than 60% of approved FDI flows to Ethiopia originated from developing economies, mainly from Saudi Arabia, India, China, and Turkey (Ethiopia Investment Authority). In 2010, there were about 316 Chinese investment projects in Ethiopia and over 900 projects were in pre-implementation phase (Ethiopia Investment Authority). Indian investments in Ethiopia totalled about 400 million USD in 2005, but in 2010 the investment volume increased nine-fold and reached over five billion USD with investment from 500 Indian companies (Embassy of India in Ethiopia). The Indian investment volume is expected to double to \$10 billion by 2015 (Ethiopia Investment Authority).

Climate technology transfer to Ethiopia from other developing countries focuses mainly in the area of sustainable construction materials and smart building systems, hydropower turbines, wind turbines, electric trains, energy-efficient electric lights, and large-scale industrial process equipment for metals, and other less energy-intensive industries. Table 5.1 presents the potential of developing countries to manufacture and export climate technologies, and the Ethiopia experience in acquiring these technologies from its southern partners. The table indicates that climate technologies that are suitable for use in developing countries such as Ethiopia could be available from other more industrially-orientated developing countries. It confirms the fact that developing countries can offer recipient nations appropriate climate technological solutions.

TABLE 5.1 GAUGING THE POTENTIAL OF SOUTH-SOUTH COOPERATION FOR EFFECTIVE CLIMATE TECHNOLOGY: POTENTIAL AND THE ETHIOPIA EXPERIENCES

Green technologies	Technologies and services	The potential ⁴ of the SSC for climate technology transfer in Ethiopia
Cleaner energy supply	Wind power, biomass, biogas, hydropower, mini-hydro, and micro turbines, waste-to-energy, landfill gas. Solar power (photovoltaic, concentrated solar, solar thermal)	<p>High potential: - the first ever wind farms in Ethiopia at two sites with a combined capacity of 171 MW were constructed in 2011. The mechanical work for one of the projects (Adama project) was undertaken by Hydro China while the Chinese contractor CGOC was in charge of the civil work, with financial support from the China government. To facilitate technology transfer Addis Ababa University was working side by side with the Chinese companies (Ethiopia Investment Authority, Ethiopia Ministry of Industry and Commerce).</p> <p>- The Industrial and Commercial Bank of China (ICBC) provided a US\$400 million loan for Ethiopia's Gibe 3 hydropower, which is being constructed with a total investment of US\$1.75 billion and will generate 1,870 MW. The Chinese company, Hydro China, is undertaking the mechanical work (EEPCo and Ministry of Finance and Economic Development)</p>
Technologies to improve agriculture	Climate-resistant products and processes appropriate for changing environments (such as higher yield seeds for more arid and saline soils together with drought-resistant cultivation practices) and tools to understand and insure against climate risks with improved early-warning system processes (sea-walls, drainage capacity, reductions in environmental burden of disease, and water, forest and biodiversity management, Mechanical irrigation and farming techniques).	<p>High potential: - To enhance bilateral agricultural technologies exchange between South Korea and Ethiopia, the Korean Project on International Agriculture (KOPIA) opened its international office in Addis Ababa in July 2011. KOPIA works on the development of locally adaptable technologies; exchange of programs for scientists and experts on foods, horticultural, bio-energy, fodder and tropical crops, livestock and genetic resources (KOPIA study visit on September 2011).</p> <p>- More than 20 Ethiopia Agricultural research Institutes have joint research projects with Indian counter parts. Indians are the largest single investors in Ethiopia Agriculture where the Ethiopia government had earmarked three million hectares of land that has been leased out to Indian agriculturists (Central Statistics Agency of Ethiopia, Embassy of India in Addis Ababa).</p> <p>- Ethiopia-China Agricultural Technology Demonstration Center was established in 2010 in Ginci, Ethiopia. The centre serves as both a training and demonstration centre and is led by Chinese experts (Ethiopia ministry of Industry and Commerce).</p>
End use technologies	Electric and hybrid vehicles, carbon capture and storage (CCS). Compressed air energy storage. Pumped air and water. Molten salt, solar ponds, cryogenic liquid air or nitrogen, seasonal thermal.	<p>Low potential: The government of Ethiopia has excluded CCS from its strategy with a belief that CCS represents little or no significant abatement potential for Ethiopian industry (Ethiopia Environmental Protection Authority)</p>
Resource and Energy efficiency	Alternative and sustainable raw materials, heating, energy-efficient lighting, production processes (new uses of waste and other by-products from firms into production inputs at the same or other firms), energy audits, feasibility studies and related technical services. Project development. Building materials, insulation. Consumer/user education. Metering, monitoring and control devices.	<p>High potential: - Pulverized fly ash and limestone has been used in Messebo Cement to reduce the use of raw materials such as clay with the support of Pakistan expatriates (Messebo Cement Factory study visit on May 2011)</p> <p>- An Egyptian company called Elsewedy Cables Ethiopia is manufacturing power-saving bulbs at its Addis Ababa factory (Elsewedy Cables Ethiopia study visit on April 2011).</p> <p>- Governmental and non-governmental organizations have made various efforts to introduce and disseminate improved stoves known as Mirt, Gonzie and Lakech in the society. Lakech reduces charcoal consumption by up to 25% compared to the conventional charcoal stoves made of sheet steel. Experience sharing in efficient cook-stoves is undergoing with Uganda Carbon Bureau (Uganda), Climate Care (Kenya), and Hestian Innovations (Malawi) (Ethiopian Rural Energy Development and Pro-motion Center (EREDPC).</p> <p>- SKY Global PLC, an Indian company, processes ferrous, non-ferrous metals and other recyclables in Ethiopia and has made a significant contribution for enhancing sustainable metal consumption in the country (SKY Global PLC study visit on April 2013).</p>

⁴ The grading (High, Medium, Low) was based on the result of focus group discussion conducted with experts on April 22, 2011 in Addis Ababa and interviews with Wuppertal Institute and phone interviews World Resource Institute on June, 2011

Green buildings	Green building design, climate-friendly cement, construction and contracting, smart building systems, Thermal insulation and new materials, urban design (including land use).	Medium Potential: The transfer of a patented environmental technology named “FGC” from Sichuan Xinghe Company Ltd, China, has been transferred to Ethiopia successfully. The technology enables the manufacturing of construction materials from straw and in Ethiopia it is being used widely in partition boards, walls and doors. The Ethiopia Ministry of Industry data indicated that the use of FGC products has resulted in a 50% reduction in the cost of building houses.
Transportation	Urban design/land use. Electric train, Non-grain biofuels. Vehicle motors, parts, components systems	High potential; - The Chinese company China Railway Eryuan Engineering Group Co. Ltd. (CREEC) has started constructing the Addis Ababa light train transit (Addis Ababa City Road and Transport Bureau). -India has advanced \$300 million for the rehabilitation of the Ethio-Djibouti railway line (Embassy of India in Addis Ababa, Ethiopian Railways Corporation). - Gasohol -10 % ethanol and 90 % gasoline blend (E 10) is being blended by a Sudanese Petroleum company, Nile Petroleum, in Addis Ababa, and is being used in standard vehicles (Ethiopian Petroleum Enterprise).
Services	Consulting and engineering: emission inventories, studies, efficiency, renewables, other power systems.	High Potential: - Nationwide Wind and Solar Energy Grid Based Master Plan Project is being developed with the financial and technical support of the Government of China (EEPCo). - ARUN Goswami, an Indian company, exports recyclable materials from Ethiopia (National Bank of Ethiopia).

Source: Author own compilation from study visits and government agencies' data.

Reflecting the growing trade and investment ties of Ethiopia with the global south, the country's foreign policy has been focusing more on the south, however, sometimes that comes at the cost of its historical relations to the north. For instance, the late Prime Minister, Meles Zienaw, during his foreign policy strategic direction speech on April 10, 2010 said "At the moment, there is no major trading relationship between us and Sweden, and no significant investment coming from Sweden to Ethiopia. At the same time we don't have an embassy in Brazil. Brazil is a huge emerging country, and so we are now reassessing our diplomatic presence globally and the first to go was Sweden because it was not worthwhile to have an embassy there." (Ethiopia TV-etv, Amharic program, 10 April 2010). But not everyone agrees with this approach and others have commented, "The government of Ethiopia is shifting alliances not just because of economic realities but mainly because of political facts. The government has enormous pressure from the west to improve its democratic governance and to ease that pressure the government is playing the alliance shifting game" (Interview anonymous, April 19, 2011).

The political elite in the ruling Ethiopian People's Revolutionary Democratic Front (EPRDF), in particular the then party head and the Prime Minister, Meles Zienawi, is influenced by the successful economic management of latecomers, especially Korea and Taiwan. In his article, Meles Zienawi "African Development: Dead Ends and New Beginnings" he extensively discussed the success stories of emerging economies and the lessons other developing

countries such as Ethiopia could learn including in the area of technology development (Zienawi, 2006).

Ethiopians have mixed views regarding the increasing alignment of the government to the global south countries, developing countries increasing investment in Ethiopia and the technological lessons the country could take from those countries. The following statements reflect these views.

- “Ethiopia could witness in recent years the emerging economics in particular China and India had had an enormous, significant and positive impact in Africa including in the area of technology transfer” (Interview with Masresha Mekonen on July 23, 2011). “ ...Yes, there had been progress but much remained to be done to allow Ethiopia to benefit from transfer of technology available in the context of South-South cooperation and North-South relations (Interview with Birhanu Assefa on July 10, 2011).
- “China is importing many of its own nationals to work on reconstruction projects and manufacturing industries in Ethiopia, leaving little employment for Ethiopians, pays much less than local companies, and not allowing for cooperative working relations or the transfer of knowledge and skills” (Interview with Hayle-Yesus Tsehay on August 15, 2011).

Despite the different opinions of Ethiopians, global south influence in climate technology transfer has mounted, including the design and development of climate technology related policies and strategies.

In 2010 the Chinese government provided both financial and technical support to the government of Ethiopia for the development of the country’s renewable energy strategic plan (Source: Ministry of Finance and Economic Development).

A large group of experts drawn from different ministries such as the ministries of science and technology, energy and water, and environmental protection made quite frequent technology transfer study tours to Korea, China, Taiwan, South Africa, and Malaysia between 2009 and 2011 (Source: Science and Technology Ministry, Environmental Protection Authority, Ministry of Energy and Water). The purpose of the tours was to draft policies and strategies such as the renewable energy strategy and science and technology policy through experience sharing in technological policies and strategies. Highlighting the importance of these kinds of technology transfer mechanisms, Banik and Subbayamma (2000) reported that technology could be transferred through study tours, written documents, telephone conversations, e-mails, memos, reports, newsletters and journals. These experience sharing business missions have also helped in establishment of the “Technology Transfer and Development Directorate” in 2010 as one of the core processes in the Ministry

of Science & Technology (MoST). One of the objectives of Directorate is to establish a system that can be effectively implemented for technology transfer and development on the basis of significant benchmarks of different countries, especially countries of the global south. The latest Ethiopia science and technology policy was drafted in 2011 with the help of Korean experts (Source: Science and Technology Ministry). In line with this focus, a high official at the Science and Technology Ministry said “We, in the Ethiopia government, believe that Korea and other emerging economies are our best choices for our technology transfer strategy” (Interview with Daniel Gizachew on April 20, 2011).

An article written in the Amharic language (Ethiopian national language) to the EPRDF cadres by the late Prime Minister himself, stated that the EPRDF political document and the Industrial Development Strategy of Ethiopia all refer to what the lessons from global south countries, in particular Taiwan and Korea, hold for Ethiopia's development.

The most important policy document of the current Ethiopia government, Ethiopia's five year Growth and Transformation Plan (GTP) adopted in 2011, draws on the best experiences in effectiveness of technological policies from emerging economies, mainly South Korea. In the early phase of South Korean development much of industrial production took advantage of an abundant labor supply and later moved into consumer goods industries and more capital-intensive industries (Kim 2000). The Ethiopian government would like to adopt similar industrial development stages, corresponding to the notion of technological learning, which could ensure higher levels of technological sophistication.

The transfers of technology from emerging economies through trade, investment, training and human movement, have been an important element in Ethiopia's various strategies for development of domestic capabilities. One of the driving forces of South-South Cooperation, as was mentioned in Section 5.2, is the technological advance of countries like China, India, Brazil, South Africa, Malaysia, Turkey, the Republic of Korea, Indonesia, Egypt and some others. These countries already have a certain capacity for domestic technology development for technologies related to greenhouse gas emissions reductions, fueled mainly because of government support to organizations dedicated to research, development, technical assistance, and funding of equipment in these areas.

Under the framework of the SSC, climate technologies are transferred to Ethiopia through both market mediated and non-market mediated routes. The areas where there are formal contracts, and direct involvement of foreign firms, are the ones for which markets exist. For channels like imitation, scientific exchange, exhibitions etc. no functioning market exists. Of course, the most common method of technology transfer to developing countries appears to.

TABLE 5.2 GAUGING THE POTENTIAL OF SOUTH-SOUTH COOPERATION FOR EFFECTIVE TECHNOLOGY TRANSFER: POTENTIAL AND CHARACTERISTICS OF TECHNOLOGY TRANSFER CHANNELS

Channels	Characteristics and examples	Potential ⁵ for Climate Technology Transfer in Ethiopia
Technology transfer through goods/products	<p>- Local firms have to do reverse engineering if they have to benefit from this channel, which depends on the skill content of the labor and local absorptive capacity (Kathuria, 1999).</p> <p>-Technology transfer through goods/products in Ethiopia has been hampered by</p> <ol style="list-style-type: none"> 1. Insufficient knowledge of the global environmental technology and related services markets. 2. Lack of data and information about the Ethiopia market for technology suppliers 3. Limited local capacity to do reverse engineering 4. Weak capacities and networking of trade support institutions for promoting south-south trade in the sector 	<p>High: - New products often embody new ideas and innovations and when these products are traded internationally, they transmit knowledge across borders (Bayoumi et al. 1999 and Basant and Brian 1996).</p> <p>- Half of the leading local firms in Ethiopia have emerged from the trading sector; for this is often where the deepest and most acute knowledge of local and international market conditions is already at hand (UNCTAD 2011)</p> <p>- To enhance SSTT and create a new market chain and generate exports for project partners, a series of business round tables, study tours and buyers-sellers meetings have been organized by the Ethiopian government and its southern counterparts (Ethiopian Chamber of Commerce and Sectorial Associations, Ministry of Industry and Commerce).</p>
Technology transfer through Foreign Direct Investment (FDI) - wholly owned subsidiary	<p>- FDI in Ethiopia has steadily increased from less than USD 820 million in 2008 to more than USD 2 billion in the first half of 2010/11 fiscal years (Ethiopia Investment Authority).</p> <p>- Ethiopia is one of highest dependence LDCs on FDI from other developing countries (source: Ethiopia Investment Authority) where more than 60% FDI comes from developing countries. In many other LDCs it is slightly over 40% of the total inward FDI (UNCTAD 2007).</p>	<p>Medium: - FDI is the primary 'agent' of technology transfer (Reddy & Zhao, 1990).</p> <p>- The increasingly expanded state owned companies in Ethiopia have a specific objective of boosting local absorptive capacity to benefit more from FDI induced technology. However, the lower competitiveness of some southern companies relative to local firms, and their very limited linkages with local enterprises at the firm level, have hampered the potential of FDI for SSTT in Ethiopia (For further information see Chapter 6).</p>
Technology transfer through joint ventures	<p>An Indian company called ANMOL Group established a joint venture called Anmol Products Ethiopia PLC with 60% share and a 40% Ethiopian owned. Anmol Products Ethiopia PLC uses waste paper that is usually burnt or thrown away (Anmol Products Ethiopia PLC study visit on April 2011).</p>	<p>High: - Firms choose to transfer technologies through joint ventures because joint ventures offer a unique opportunity of combining the distinctive competencies and the complementary resources of participating firms (Hobday and Rush 2007, Ivarson and Alvstam 2005, Pack and Saggi 2001).</p> <p>- Firms from other developing countries that have actively sought to market environmental products and technologies for commercial reasons in Ethiopia are finding increasingly that they must establish joint ventures in particular with either state owned or EPRDF affiliated companies (For further information see Chapter 6).</p>
Technology transfer through movement of workers (labour turnover and hiring expatriates)	<p>- The development of quality control by X-ray system (QCX) in the Ethiopia cement Factory (the only cement factory in Ethiopia with the QCX system in the 2000s) is one such example where there were 600 workers with 25% Chinese, 12% Turkish, 5% Indians and 1% Danish and British. The objective of the expatriates was to train local employees on the job. The people trained in QCX in Messebo are now working in more than 15 cement factories throughout the country. The QCX system enhances resource efficiency and productivity through emission reduction (mainly CO₂), reduction of energy consumption, use of alternative fuels and raw materials. The expatriate training was also instrumental in the production of an environmentally friendly product called Portland-Limestone Cement (PLC) (For further information see Chapter 6).</p>	<p>Medium: - Labor turnover is an important channel for technology transfer and technology diffusion (Osman-Gani 1999)</p> <p>- In Ethiopia companies from the south mainly hired their own experts and leave few positions for the locals, in particular for skilled professionals. This has negative consequences for enhancing SSTT. On the other hand, however, since they don't curtail labor turnover by offering higher wages and better working condition than local rivals offer, there is higher labor turnover. This could enhance technology diffusion but most of these local employees are junior professionals and skilled laborers where-as higher skilled professionals don't have the opportunity to be employed by these companies at the first place (For further information see Chapter 6).</p>

⁵ The grading (High, Medium, Low) was based on the result of focus group discussion conducted with experts on April 22, 2011 in Addis Ababa and interviews with Wuppertal Institute and phone interviews World Resource Institute on May, 2011.

be through market mechanisms (Lovett et al. 2012). However, technology transfer to places such as Ethiopia where there are insufficient absorptive capabilities, and where dedicated technology transfer of climate technology transfer is a policy goal, non-market mechanisms and policy intervention are necessary for effective climate technology transfer particularly in least developing countries (Cameron 2005, Morsink et al. 2011).

Table 5.2 illustrates the three key channels: trade in goods, foreign direct investment and movement of people. The potential of each of the channels for climate technology transfer in Ethiopia, basic characteristics and practical examples, are also reported in the table. The table indicates that trade in goods and products and FDI have higher potential for the transfer of climate technology transfer under south-south cooperation.

5.4 THE ADVANCEMENT OF SOUTH-SOUTH CLIMATE TECHNOLOGY TRANSFER: MOTIVES AND JUSTIFICATIONS

Ethiopia is neither an oil nor other natural resource producing country, so natural resource seeking doesn't seem to be a major motivational factor for SSTT in a country like Ethiopia. The realistic school of thought, however, views the stronger presence of emerging economies like China and India in the less developed other southern countries as a "monolithic dragon scrambling for natural resources to service their own growing capitalist economy" (Mohan and Power 2008). In order to understand the main drivers of south-south climate technology transfer in Ethiopia, a survey was conducted, and seven potential motivations tested for SSCTT in Ethiopia.

The seven tested motivations include: (1) Ensuring political security and creating an international influence, (2) Creating environmental wellbeing, (3) Finding the optimal technological gap between transferor and transferee, (4) Creating and expanding markets, (5) Better business environment in Ethiopia than transferor home country, (6) To take advantage of skilled labor in Ethiopia, (7) Use parent company's advantage in cost management. Among the 66 respondents of the survey 36 of them (54.5%) indicated that the first four should be treated as main motivations for climate technology transfers in Ethiopia from emerging economies. Where-as the last three were listed by 54.5% of respondents as factors that are not important in the current Ethiopian context.

The realist school of thought views the motives of involvement of the global south powerhouses, in particular China and India, in LDCs such as Ethiopia, as a political strategy employed by these countries to have weaker least developed countries under their control, and thereby exploiting their resources (Schweller 1997). Whereas the dependency theorists pointed out that the natural motive of the developing countries to eliminate the structural divide between the center and the peripheries is the driving force for intra-investment

amongst peripherals (Burbach and Robinson 1999). Based on these assumptions, the dependency school of thought has been advocating South-South Cooperation (SSC), that is, cooperation between the “peripherals”. The concept of SSC for dependency theorists such as Cardoso and Falleto (2004) and Senghaas (1979) is understood as a mechanism through which countries of the global South (the periphery) would be enabled to overcome dependence from the industrialized nations of the global North (the core).

5.4.1 ENSURING POLITICAL SECURITY AND CREATING AN INTERNATIONAL INFLUENCE

Creating an international influence seems to be a powerful factor for technology transfers in Ethiopia from emerging economies, in particular for attracting some sort of Chinese investments to Ethiopia. In this regard the realist school of thought argued that SSC is a strategy used by the dominant emerging south states to secure power (Mundy 2007) and it is promoted by regional hegemonic powers (BICS) to consolidate their dominance and influence; and it would be effective as long as it doesn't diminish their power (Karns and Mingst 2004; Woods 2001).

China is now looking to anchor its African investment in Ethiopia based on the close political cooperation of both countries. For instance, China has put its remarkable technological footprint in Addis Ababa major gateways, where diplomats from Africa and other continents can see and appreciate its technological advancement and friendship. The main roads to the new Addis Ababa airport, including the ring road and flyover close to the airport, and the new African Union headquarters, are financed and built by the Chinese. These things aren't only a mark of China's growing engagement with Ethiopia, but also demonstrate Chinese strategies to secure its interest in Africa through diplomatic and political capital. Ethiopia has occupied an important political role in the Africa region: its technical and military support for its fellow Africa countries during independence struggles, its central role in establishment of the Africa Union and its predecessor, the Organisation of African Unity, hosting of the headquarters of the Africa Union, Addis Ababa is home to the third largest diplomatic community in the world, behind New York City and Geneva, and the country has the aspiration of being seen as a representative of Africa in particular.

Isolating Taiwan and securing loyalty is a particular ideological motive for transfer of technology specifically from China to Ethiopia and other developing countries. The Sino-Ethiopia diplomatic relations was established on December 1st 1970 when China agreed to recognize Eritrea as Ethiopian, in exchange for Haile Selassie's (Emperor of Ethiopia) recognition of Taiwan as Chinese. The economic and political ties of Ethiopia and Taiwan are almost insignificant compared to those with China. Taiwan exported goods (mainly machines) to the value of 2.7 million US dollars to Ethiopia at the end of 2010, which is much

lower than the 1.1 billion the China export to Ethiopia (Ethiopia Ministry of Finance and Economic Development). Alemayehu Geda (2008) attributed the main success of Chinese firms in Ethiopia to the political ties their government created with the current government of Ethiopia. Through Africa, China has also found a way to isolate Taiwan, its diplomatic archrival. China has continued exchange programs with Ethiopia where loyalty to the mainland might otherwise waver in face of the generous economic assistance offered by rival Taiwan. Gillespie (2001) has described how technology transfer between China and African countries were fuelled by China's concerted effort to secure and retain the loyalty of African regimes with a leftist bent. Ideology has since given way to more pragmatic considerations since the end of the Cold War, but it still plays a part in SSTT.

5.4.2 CREATING ENVIRONMENTAL WELLBEING

The research finds neither policy nor practices that position the creation of environmental wellbeing as a motivational factor for climate technology transfer to Ethiopia from its southern partners. The head of environmental law and international cooperation at the Ethiopia Environmental Protection Authority (EPA) said “Ethiopia doesn’t have significant environment and climate change cooperation with the major players of the global south countries such as China, India, Brazil, and South Africa” (Interview with Wondwesen Wendimagegnehu on April 23, 2011). To the contrary, some environmental monitoring reports at the EPA indicate that there are environmental concerns about the various emerging economy investments in Ethiopia. “The perceived lack of priority given to environmental and social safeguarding is almost a common criticism of South-South co-operation in infrastructure development in Ethiopia” (Interview with Wondwesen Wendimagegnehu on April 23, 2011). For instance, some Chinese and Indian contract-based projects are operating in ecologically sensitive regions, where they have failed to adhere to environmental guidelines. Unlike other international financial institutions such as the World Bank and western bilateral agencies, the Chinese and Indians investors and financiers (such as the Export-Import Bank of China) fail to undertake their environmental guidelines when lending the concessional loans as part of their official development assistance program (Bosshard 2008).

Critics have expressed concern that the Ethiopian government has prioritized short-term development over long-term environmentally sustainable economic growth (Interview with Mehari Asfaw – Ethiopia Environmental Forum on April 20, 2011). In spite of absence of environmental cooperation in the SSTT, Ethiopian technological cooperation with its southern partners has been influenced by an extensive set of international climate change policies and cooperation and, more recently, by it's the role of its late prime minister, Melese Zienawi, in the international climate change discussions as the representative of the Africa Union. The

leadership aspiration of the PM in climate change has helped in securing political endorsement for domestic environmental issues, in particular the climate change agenda. Therefore, in the universe of environmental related issues, climate technology transfer from the global south to Ethiopia is driven by the pull factors that are characterized by international climate politics and regional leadership in climate change.

5.4.3 FINDING THE OPTIMAL TECHNOLOGICAL GAP BETWEEN TRANSFEROR AND TRANSFEREE

Ethiopia as a transferee is looking at emerging economies (transferor) as the one with an “optimal” potential technological gap. Technology transfer is not obtainable if there is too big or too small gap of economic development, organizational strength, knowledge, and norm between transferor and transferee, as explained by the Sharif and Haq (1980) technology transfer model. This model proposes the concept of a potential technological gap between a transferor and transferee, and argues that when the potential technological gap is either too great or too small between the transferor and transferee, the effectiveness of the transfer is low. It suggests that when a transferee first looks for a potential transferor it is important to look for one with an “optimal” potential technological gap.

The technology gap between Ethiopia and the global North countries is definitely higher than the gap between Ethiopia and other developing countries. However, as noted by Alemayehu Geda (2008) in some sectors, such as footwear, plastic, cement, and textiles, where the emerging economies are involved in a form of FDI and trade, it seems that Ethiopia has failed in finding the optimal potential technological gap. The small technological gap means that the companies and products in these sectors from the emerging economies are crowding out Ethiopian domestic firms, which are less competitive. The low absorptive capacity of the country for technologies coming from developed countries affects the effectiveness of the technology transfer. In this instance, it is not only Ethiopia as the transferee, but also firms in the global North (the transferor), who are not interested in engaging in the process of technology transfer, due to the high cost of shrinking the technology gap and to make the technology transfer happen (Glass and Saggi 1998).

5.4.4 CREATING AND EXPANDING THE MARKET

The prospect of reaching Ethiopia’s large and growing domestic markets has spurred global south firms to seek opportunities for establishing manufacturing bases in Ethiopia, requiring transfer and adaptation of equipment and know-how. As economic activity has expanded (at an average rate of 7–10% per year from 2006 to 2011), Ethiopia is becoming a much wealthier country than two decades ago. The consequences for technology transfer have been manifold. Opportunities for commercial exchanges with other countries have multiplied, and Ethiopia has had greater ability to import the commodities and technologies it desires.

The rate of growth of Ethiopian environmentally sound technology imports is one of the fastest in the world. Data⁶ from the National Bank of Ethiopia indicates that growth of climate technology imports increased by 757% from 2004 to 2010, while the import growth of other types of technologies⁷ on the same year was only 350%. Imports from the USA alone grew by 370 %, whereas from China and India grew by 850% and 771% respectively.

5.5 THE CHARACTERISTICS OF SOUTH-SOUTH CLIMATE TECHNOLOGY TRANSFER

The official policy statements of developing countries at the UNFCCC, any other international regime meeting, or in national policy documents, characterize south-south technology transfer (SSTT) as a technological cooperation based on respect for national sovereignty; national ownership and independence; equality; non-conditionality; non-interference; and mutual benefit. For example, official statements of the Ethiopian government, as expressed in its five year Growth and Transformation Plan and foreign policy, indicate that the country's relationship with its Southern partners is based on the need and desire to pursue mutually beneficial cooperation for common development.

Apart from these kinds of political statements, what are the characteristics of SSCTT in practice? What makes it different from NSCTT? The realist school of thought has a simple answer for this, they argue that SSTT is not different from NSCTT, but rather it is essentially subject to the same dynamics and analytical tools as NSCTT (Kreitlow 2007). Whereas the dependency school of thought views SSCTT as technology transfer based on equal interaction a means of self-reliance and an alternative to the exploitative NSCTT (Smallman and Brown 2011; Darity and Davis 2005; Haq 1980; Frank 1971).

In order to find out the characteristics of SSCTT in practice, a survey was conducted and respondents asked two questions. First, respondents were asked to list the characteristics of SSCTT vis-à-vis the NSCTT in five areas: (1) Technological cooperation approach (2) Investment focus and ownership type (3) Labour movement and local linkages (4) Technology and industrial scale (5) Export composition. A summarized response for each of the five areas is presented in Table 5.3. Second, in order to get new insights into the characteristics of SSCTT, respondents were asked to list the characteristics of SSCTT, with examples as they had experienced and perceived.

The characteristics, which were listed by the respondents, were categorized into three broader areas in order to capture as many as possible responses. (1) Cooperation type and

⁶ For the purpose of this calculation the US International Trade Administration's (ITA) Office of Energy and Environmental Industries (OEEI) Classification System and list of products for the ET industry was adopted by the author.

⁷ "Other types of technologies" for this calculation were those that were classified as non-climate technology.

power relationship (2) Long-term strategic vision, and (3) State Capitalism. The response of 71% (47 of the 66 respondents) of respondents fell under these three characteristics. The response of the remaining 29% was inconsistent, or was rejected due to poor data quality (such as answers, which didn't reflect the actual question). Discussion of the three major characteristics is presented in Table 5.3. The discussion on the three characteristics also further elaborates the responses presented in Table 5.3.

TABLE 5.3 CHARACTERISTICS OF SOUTH-SOUTH TECHNOLOGY TRANSFER VIS-À-VIS NORTH-SOUTH TECHNOLOGY TRANSFER

Dependency aspects	TT through SSC	TT through NSC
Technological cooperation approach	- "Business is business" approach. No-strings-attached policy towards technology cooperation. Has limited intension in supporting the improvement of Ethiopia institutional infrastructure and macro level knowledge transfer.	- Conditions and requirements are attached for changes in the Ethiopian legal and political structure but in most cases the conditions don't ensure institutional and systemic changes because the requirements focused on short-term changes such as the release of political prisoners.
Investment focus and ownership type	-The major companies in Ethiopia from the global south are mainly state-owned enterprises (Central Statistics Agency of Ethiopia, Ethiopia ministry of Industry and Commerce, Ethiopia Investment Authority). -Focuses very much on the secondary sector (e.g., tannery, food, beverages, textiles, pharmaceuticals), where the sector absorbs more than 45% of the FDI flows in Ethiopia (Central Statistics Agency of Ethiopia, Ethiopia Ministry of Industry and Commerce).	-All major companies from the developed world are private enterprises (Ethiopia ministry of Industry and Commerce, Ethiopia Investment Authority). - Technology and knowledge transfer is mainly in the tertiary sector (e.g., hotels, tourism, consultancy), where the sector is the second most attractive to FDI (Ministry of Finance and Economic Development, Ethiopia ministry of Industry and Commerce, Ethiopia Investment Authority).
Labor movement and local linkages	- Lower working conditions and wages in the global south companies in Ethiopia caused higher turnover. The turn over helps in facilitating technology transfer to local firms. On the flip side, they have weak linkages with domestic enterprises, and therefore the opportunities they offer for the dissemination of technologies and knowledge in Ethiopia is limited (for further information see Chapter 6).	- Higher working conditions and wages in the companies that come from the developed world caused limited labor turnover. Whereas their strong linkages with domestic enterprises facilitates the diffusion of technologies and knowledge to local enterprises (for further information see Chapter 6).
Technology and industrial scale	- Labor intensive, relatively cheaper and often more applicable given the comparable level of development, similar climatic conditions and often geographical and cultural proximity, in particular firms from Africa countries, India and Middle East (Central Statistics Agency of Ethiopia, Ethiopia Ministry of Industry and Commerce). - Has resulted in crowding out of some domestic firms because of mainly their lower competitiveness in technological advancement (Alemayehu 2008).	- Capital and knowledge intensive, and technically advanced products. Superior technology is the most common firm-specific advantage over local companies (Central Statistics Agency of Ethiopia, Ethiopia ministry of Industry and Commerce). - The technology spillovers have the potential to improve the productivity of domestic firms and thereby stimulate economic growth (Xu and Wang 1999).
Export composition	- Primary commodity exports/ cheap manufactured product imports (National Bank of Ethiopia).	- Primary commodity exports/capital goods imports (National Bank of Ethiopia).

The following section elaborates the responses presented in Table 5.3 by presenting characteristics of SSCTT into three categories.

5.5.1 COOPERATION TYPE AND POWER RELATIONSHIP

There is a general perception amongst the ordinary citizens of Ethiopia and higher government officials, that the relation with the global south is a partnership of equals. However, trade data from the Ethiopia National Bank shows that there is little evidence that Ethiopian relations with the global south have caused a structural and fundamental transformation of the standard dependency features.

It has become increasingly common to find Chinese and Indians in the rural parts of Ethiopia building bridges, hospitals, schools, and water treatments alongside the locals. Reflecting on this, a professor at the institute of technology, Addis Ababa University and chairman of Transparency Ethiopia, Birhanu Assefa said “Chinese and Indians who live out in our villages, working directly with locals, not caught up in endless meetings in the capital city or writing reports” (Interview on July 10, 2011). The very presence of outsiders in rural communities that are not used to seeing foreigners is an important stimulus for change. The skills they bring are passed on to the communities in which they work and a multiplier effect is achieved through training of local technicians who can spread the word to others after the foreigners have gone back home. In places like the North East and Southern parts of the country, where even some Ethiopia professionals are not interested to go and work because of security and economic reasons, it is not unusual to find Chinese engineers working with local technicians. On the other hand engineers from the North are concentrated in the big cities, in particular in Addis Ababa, and unlike in some Northern originated CSOs, North technical professionals mostly do not integrate with the local community. The engagement level of foreign experts with local community (management of cross-cultural adjustment) has a direct effect on the effectiveness of technology transfer (Black and Gregerson 1997).

Reporting on the level of cross-cultural adjustment, the production manager of Messobo Cement Factory, (located 800 km away from the capital city), Kasim Sirag said “While Danish and British engineers have been sometimes working from Addis Ababa, Turkish, Chinese and Indians have been working and staying in the premises of the factory”. These practices have clearly created a general perception amongst the ordinary citizens of Ethiopia that the relation with the global south is a partnership of equals. The survey conducted by the author in Messebo Cement factory where there were 600 workers with 8% Chinese, 11% Turkish, 6% Indians and 13% Danish and British, reflected the above understanding of the ordinary citizens. 35% of the respondents⁸ considered their counterpart Chinese colleagues on a similar position as equals in the workplace, where as 30% said Turkish, 20% Indians and 10% said Danish and Britons.

⁸ The survey covered 65 mid-level careers (engineers, chemists, shift engineers, and senior chemists).

In cross-country working relationships, there is also a feeling among the higher government officials that the partnership of Ethiopia with the global south is based on a shared solidarity born out of similar experiences and sympathies, which is guided by the principles of equals and respect for national sovereignty and ownership. Gosaye Abayneh, a higher official at the Ethiopia ministry of Energy and Water said, "The cooperation between Ethiopia and emerging economies entails an equal relationship between us. We have China and other developing countries with equal partners in our transformational and five years development plan" (Interview on June 20, 2011). Unlike the ordinary Ethiopians, the government understanding of "equal" partnership could be the result of the Chinese and some global south countries "non-intervention" approach to their aids and investments. On the other hand, Western investments and aid, which have undertones of various forms of conditionality, such as the formation of free trade, building private companies, or relaxing government regulations, the emerging economies investments in Ethiopia are based on flexible soft loans and are tailored to lift the overall economic performance of Ethiopia (Interview with Gosaye Abayneh on June 20, 2011).

However, the realist school of thought challenges the claim that the partnership between Ethiopia, and other global south emerging economies such as China, is between 'equals'. The concept of South-South Cooperation - presuming a horizontal and equal interaction - neglects the existence of economic and power asymmetries as well as the possibilities of dependencies between the countries of the South themselves. As pointed out by Carlsson (1982), the most serious problem is not connected with the actual establishment of intra- South trade, but its general effects on the development prospects of its participants. In the case of South-South trade it is likely that a replication of the exploitative North-South trade relationship will occur and the weaker economies of the South will continue to lag behind (Kreitlow 2007; Woods 2001). This is, for instance, evident by trade data from the Ethiopia National Bank, which shows there is little evidence that Ethiopian relations with the global south caused a structural and fundamental transformation of standard dependency features. For instance, Ethiopia exports to emerging economies the same primary commodities mainly coffee, leather, and other raw materials that it has been supplying to the global north. The National Bank historical data reported that 40 years ago (in 1972) when Ethiopia almost exclusively exported coffee to developed countries, coffee amounted to 43.8% of exports, and now where the emerging economies are major destination of the country exports, exports are still almost entirely agricultural commodities, and coffee remains as the largest foreign exchange earner; amounted to 40.6% of the country export. The lack of economic structural reconversion does not support the long run economic growth that the country badly needs. First, commodity prices are highly volatile; the country has had to cope

with large shocks, both positive and negative. Evidence from 1998 to 2000 shows recurring drought has severely hampered the country's coffee production. The largest of these shocks were poorly managed, with negative impacts causing substantial contractions in the output of coffee and other commodities. Further, as asserted by dependency theories, reliance on export of primary commodities does not expand the value added of exported products (Graaff and Venter 2001; Wallerstein 1980), which thus prevents Ethiopia from generating the rapid economic growth seen in other emerging economies.

Advocacy groups and individuals such as Hayle-Yesus Tsehay, an activist on transparency in trade and director of one of the largest CSOs in Ethiopia, have been warning Ethiopia officials about the danger of replicating Ethiopia's economic relationship with northern countries by simply exporting primary commodities to China, India and other emerging economies, while importing cheap manufactured goods (Interview with Hayle-Yesus Tsehay on August 15, 2011).

The engagement of Ethiopia in SSC has not only had an insignificant effect on the country's trade patterns, but the trade balance with the developed world remains almost the same. For example, according to official statistics of the National Bank of Ethiopia, in 2010, China's export volume to Ethiopia is ten times larger than the Ethiopia's exports to China. During the same year, Italy, the largest trading partner of Ethiopia from the developed world, had an export volume six times larger than Ethiopian exports to Italy. This is contrary to the dependency theorists, who believe that south-south cooperation would avoid trade imbalances and disadvantageous terms of trade (Milius 2009; Smallman and Brown 2011).

Further, even though it is true that emerging economy experts have much better personal interactions and connections with local Ethiopians compared to the developed country technical professionals, at the firm level emerging economy companies have very limited linkages with local enterprises⁹. Contractual practices among manufacturing firms in Ethiopia indicate that most emerging economy companies in Ethiopia don't interact with domestic firms, but by comparison developed country companies establish better linkages with domestic enterprises on the supply chain, and therefore the opportunities they offer for the dissemination of technologies and knowledge in host economies is better in this instance¹⁰.

The Ethiopian late prime minister Meles Zenawi recognized the danger of the existing technological and economical cooperation modalities his country and the rest of African countries have with emerging economies, as evidenced in the following quote from a newspaper interview "African states must be prudent in setting the parameters of the

⁹ The methodology and the detail discussion for this finding is found in Chapter 6.

¹⁰ The detail analysis is found in Chapter 6.

relationship. The Chinese interest in Ethiopia has been nothing short of a godsend. We have benefited massively from it, but like everything else it is capable of becoming a nightmare. It is up to the host countries as to how they use the available resources from the Chinese in the best possible manner. Those who do will benefit, those who don't may not benefit as perhaps they ought to." (Mary Fitzgerald, 2010. Interview in Irish Times).

5.5.2 LONG-TERM STRATEGIC VISION

South-South technology transfer is characterized by long-term strategic vision and engagement, which is featured by the establishment of Engineering Academy programs to secure their sustainability in other developing countries, setting-up of manufacturing and assembling plants in joint ventures and creation of industrial parks.

The long term strategic vision and engagement, illustrated above, enables Ethiopia to manage technology transfer barriers, mainly the lower skill base of the country together with its global south countries. Keller and Chinta (1990) argue that effective technology transfer would be determined by the extent to which the transferor and transferee manage the barriers that impede transfer and strengthen initiatives that facilitate it. The facilitating initiatives refer to the willingness of the partners to adapt their respective strategic and operational postures to ensure a "win-win" outcome. The barriers could be political, legal, social, cultural, economic, and technological.

In 2000 – 2005 when China Road and Bridge Corporation (CRBC) built the Addis Ababa ring road, there was a serious shortage of skilled labour in Ethiopia. As a result, skilled Chinese workers were imported for the few technical and managerial positions. The Ethiopian government asked China to establish a college that would focus on construction and industrial skills. The fully equipped Ethio-China Polytechnic College opened in late 2009, funded by Chinese aid. Chinese professors offer a two-year degree with Chinese language classes alongside engineering skills for 3,000 students (source: Ethiopia Federal Government Ministry of Capacity Building). Though the establishment of Chinese funded technical schools is welcome by many as major positive signs of China's longer engagement in boosting knowledge transfer in Ethiopia, some are cautions about the manner China monopolizes sectors like the construction industry, which is mainly through low wage mechanisms. Reflecting on the nature of such mechanisms, Wipas (2000) noted that a competitiveness based on higher wages could spur technology transfer than lower wages, which has limited positive impact on boosting technology transfer.

Engineering Academy programs are a critical part of the Southern companies vision to secure their sustainability in other developing countries including Ethiopia by building a skilled pool of resources from which to draw their employees from. At the same time, the

programs are making contributions to the country's growth by helping it develop the technical skills it needs to support the leap into the competitive global economy. Samsung Electronics Co. Ltd, the South Korean electronics manufacturer has commenced establishment of the production of laptop, printer and television sets and refrigerators in Ethiopia. At the time of writing this thesis, the company was opening up an engineering academy in Addis Ababa at an estimated cost of 1.5 million dollars, in order to boost local technical and engineering skills for its future plant, and for Ethiopia in general. The academy, which would be equipped with an electronics engineering lab, will provide practical training to students from Grade 10 to 12 drawn from schools. The company, which intends to have 10,000 electronic engineers in Africa by 2015, has already opened a similar electronics-engineering academy at Boksburg, South Africa, in 2011 (source: Ethiopia Federal Government Ministry of Industry and Commerce). In a similar fashion, India and Turkey have been strengthening their technological cooperation with Ethiopia through the establishment of technical schools. South Africa has already started the establishment of joint science and technology colleges in Ethiopia to boost technological cooperation of the two countries. In contrast, it is hard to find new technical schools from the global North except the few cultural institutes that were established some years back in the 1970s and 80s.

The establishment of industrial parks by emerging economies is another feature of the long-term engagement of the global south countries with Ethiopia. One of the objectives of the industrial parks is to facilitate technology transfer and business development to help in exploiting knowledge and creating wealth. Currently, there are only four foreign investment parks in Ethiopia, and all of them are founded by developing countries, namely Turkey, Egypt, China and India. All of them have been constructed since 2010. Chinese companies involved in textiles, leather and manufacturing construction equipment have invested USD 713m for Ethiopia's first industrial park at Dukem, 37 km (23 miles) east of the capital Addis Ababa. The park has been built on a five million sq.m. plot and the China-Africa Development Fund has financed the project. Indian investors have set up an industrial zone in Kombolcha town (380kms away from Addis Ababa), which has the capacity of 50 to 100 factories. Egyptians are investing USD 300m in an industrial park, which will consist of 120 factories ranging from small-to-medium size firms manufacturing textiles and apparels as well as many other products, to large steel factories, which are projected to create job opportunities for 30,000 people. While the Turks have developed an industrial zone, which is now the biggest industrial park in the country at 14 to 15 million sq. m., Chinese investors are developing their second industrial zone in Dire Dawa, 515km southeast of Addis Ababa (source: Ethiopia Investment Authority, Ethiopia Federal Government Ministry of Industry and Commerce). The parks mainly serve companies originating from the investing country and

focused on enhancing inter-dependent relationships among the community firms, exchanging materials, water and energy in a mutually advantageous manner, each contributing to the welfare of the other. It is too early to make judgments on the performance of the industrial parks, however, if it goes as planned, the parks could enhance not only industrial productivity but also environmental performance through collaboration in managing environmental and resource issues including energy, water, and materials.

5.5.3 THE RISE OF STATE CAPITALISM

SSTT in Ethiopia is a reflection of the Latin American Structuralists school of thought where technology transfer in the country under the SSC framework is marked by state capitalism, where state control technology transfer is at the core of the government industrial policy. The dependency theorists, in particular the Latin American Structuralists believe in a larger state role for promoting technological innovation through industrial policy (Ocampo 2000).

Building on the Latin America Structuralist theory, and inspired by the development miracle of South Korea and Taiwan, Meles Zienawi, the Ethiopia Prime Minister concluded in his article that technological capability accumulation in developing countries is plagued by pervasive market failure, information failures and extreme forms of information asymmetry, of increasing returns, of extensive externalities, and coordination failures. It shows that technology has the essential characteristics of a public good. Then, he said that effective technology transfer in developing countries like Ethiopia could be materialized through the intervention of strong government, or what he called the Development State (Zienawi 2012).

The rise of state capitalism has triggered a kind of technology transfer that is facilitated and characterized by technological cooperation among state owned companies. In Ethiopia most of those state owned and party affiliated industries have technological cooperation with state owned companies originating mainly from China. The Chinese firms' technological cooperation with Ethiopia is more often mediated by formal government-to-government agreements.

In this model of capitalism (sometimes referred to as state capitalism), the state has more independent, or autonomous, political power, as well as more control over the economy (Leftwich 1995). State capitalism, understood as the widespread influence of the government in the economy, either by owning and controlling companies or through the provision of credit and privileges to private companies, seems to be on the rise not only in Ethiopia, but also in many other developing countries and emerging economies (Aldo Musacchio 2012).

In Ethiopia business and politics are strongly entwined. State-owned enterprises dominate manufacturing industries and service sectors, and party-affiliated endowments have taken many of the business opportunities left for private engagement (Altenburg 2010). Large-scale companies like sugar, power, telecommunication, cement, and steel are owned mainly either by the government of Ethiopia or by governing party affiliated endowments. In the name of endowment the ruling political party, EPRDF, controls more than 50 large-scale companies operating in the industrial, mining, construction, agro-processing, trade and service sectors. The business groups controlled by the EPRDF are said to be one of the largest conglomerates in Sub-Saharan Africa (Altenburg 2010). Party affiliated companies and state owned enterprises comprise 34.7% of the country's total investment capital, where as FDI made up 20.3% of the overall investments¹¹. The Ethiopia government is perceived by the private sector and analysts as critical of the commercial motivation of private entrepreneurs (Altenburg, 2010). Reflecting on the growing suspicious behavior of the Ethiopia government with the private sector, the owner and CEO of one private enterprise said “Unfortunately, the Ethiopian Government is suspicious of our motivation and it considers us ‘naturally rent-seeking’ and for the government the only productive enterprises are its party affiliated endowments and state owned companies” (Interview on July 10, 2011).

The suspicious altitude of the Ethiopian Government towards the private sector has limited the effectiveness of its role in facilitating partnership promotion programs to stimulate climate technology transfer through, among other things, joint-venture activities and/or private inter-firm technology and marketing partnerships. The absence of dynamic and vibrant private sector involvement has a negative effect in the country's development aspiration. As Large et al. (1992) pointed out, full sustainable and equitable development is not possible without the active contribution of the private sector in technology transfer. In the current business environment, the Government is in a unique position to play an important role in promoting market intermediation and capacity building, ultimately to put in place policies that reduce barriers to technology transfer. Unfortunately, there is no government based sector-specific environmental technology intermediaries. The government focus on monopolizing and managing businesses entities has distracted it from playing a stimulating role for technology transfer through government support systems.

5.6 CONCLUSION

The evidence of this part of the thesis on South-South climate technology transfer provided through the Ethiopia case indicates that technological cooperation of least developed

¹¹ Calculated from the official data collected from Ethiopia Ministry of Finance and governing party affiliated endowment funds - Tigray, Amhara, Oromiya, and Southern Peoples.

countries (LDCs) like Ethiopia with developed countries is diminishing and is being overtaken by the global south.

This could be explained by the concept of an 'optimal technology gap'. When the potential technological gap between a transferor and transferee is either too great or too small, effectiveness of the transfer is low (Sharif and Haq 1980). The technology gap between LDCs and the global North countries is too great, and as a result the transfer of technology is ineffective. The global North firms are less interested in being involved in transferring technology to LDCs because of the significant costs associated with shrinking the technology gap and thereby making the technology transfer effective. The LDCs themselves do not have a great appetite to engage in the transfer of complex technology where higher absorptive capacity is demanded for effective technology transfer. On the other hand, in some sectors (for instance, footwear, plastic, cement, and textiles in Ethiopia) there are cases where the technology gap between LDCs and emerging economies is too narrow, and companies and products in these sectors from the emerging economies are crowding out LDCs domestic firms because of their lower competitiveness. However, the latter case is not evident in the transfer of climate technologies because the rapid climate technological advancement of emerging economies has resulted in an optimal technology gap between the transferor and transferee. In the south-south cooperation framework, climate technology transfer is evolving mainly through trade in goods and services where most environmentally sound technologies are embodied in imported capital goods, machinery, and equipment.

Creating an optimal technological gap, and international influence along with political security, trade, and other foreign policy objectives seems to be a powerful factor for technology transfers from emerging economies to less developed countries. However, in contrast to the common expectations and traditional wisdom, there are no indications from policy or practices that a position of creating environmental wellbeing is a motivational factor for south-south climate technology transfer. Again, contrary to the findings of some researchers, technology transfer from developing countries to other non-oil or mineral resource producing developing countries like Ethiopia, natural resource seeking is not a motivational factor for south-south climate technology transfer. In addition, political solidarity of the global south countries in international climate regimes is not a major motivational factor for south-south climate technology transfer. This is mainly because of the fact that global south technological cooperation is guided by a "Business is Business" approach. This approach not only avoids attaching conditionalities to the technological cooperation, but also effectively sidelines the practical and technical impact of the G77+China alliance in

influencing and guiding the climate technology transfer process at the national level of a developing country. Yet, it still affects perceptions among politicians and policy makers.

South-south climate technology transfer is characterized by technological cooperation among state-owned enterprises. In Ethiopia, for instance the major technology cooperation is between Ethiopian state owned companies and another developing country, mainly China, state owned enterprises. This is mainly because in developing countries like Ethiopia state capitalism is inconspicuously on the rise. This finding is contrary to the notion that many developing nations are in a state of privatization, or breaking up of large state-owned enterprises that provided opportunities for south-south technology transfer (Radosevic 1995; Sadowski 2001)

Results on power relations in south-south technology cooperation are mixed. First, there is evidence that indicates south-south technology cooperation is guided by the principles of equals and respect for national sovereignty and ownership. For example, in contrast to North-South technology transfer, conditions such as respect for human rights, improved governance and competitive democracy, are not attached to south-south cooperation. These kinds of conditions are viewed by many developing countries as violations of sovereignty and the principle of country ownership. In addition to the absence of conditionality, the presence of engineers and technicians of a developing country in the rural villages of another southern country working alongside local experts and people has created the general perception amongst ordinary citizens and higher government officials that a relationship with the global south is a partnership of equals born out of similar experiences and sympathies. This perception is in particular held by politicians, and is also influenced by the spirit of the G77+China solidarity in international climate negotiations. On the other hand, evidence from trade data shows that south-south technology transfer has caused little fundamental transformation of structural and standard dependency features, which contrasts with the principle of equals and shared solidarity.

The South-South climate technology transfer has a development dimension and the potential to make a difference in critical development areas. This is evidenced by (1) the long-term strategic vision of South-South technology transfer, (2) the willingness and the potential of the transferee and the transferor to manage technology transfer barriers together. This is evident by the, for instance, establishment of specialized training colleges by companies from other developing countries to enhance the host country local absorptive capacity, and (3) the willingness of companies from the global south to invest in industrial sectors, which are identified by the host country as priorities for the national economic development. In the case of Ethiopia, the developmental impact of SSCTT is evident in the

response of emerging economies such as the China, South Korean, Turkey, India etc. to the Ethiopian government's request to establish technical colleges, setting-up of manufacturing and assembling plants in joint ventures and creation of industrial parks.

The south-south climate technology transfer is also characterized by (1) lack of environmental objectives because of its "Business is Business" approach, (2) lack of intension in supporting the improvement of the transferee institutional infrastructure, (3) limitations in private sector involvement as engine of innovations because of the rise of state capitalism, (4) limited interaction of firms on the supply chain, and (5) the model limitations in reversing the unfair North-South trade relationship.

These limitations highlight the need for adequate and effective policies for maximizing the net benefits of transferees and ensure a "win-win" outcome of the technological cooperation. As the late Prime Minister of Ethiopia, Melesse Zienawi said, host countries must be prudent in setting the parameters of their relationship with the southern transferors, otherwise, as warned by the PM, the south-south cooperation is capable of becoming a nightmare. It is, therefore, in the interests of the entire international community, and not only the host country, to adopt the appropriate instrument to regulate and facilitate the South-South exchange of climate-related technologies, and thereby to make a significant contribution to low carbon climate resilient development.

The limitations also emphasize the fact that SSCTT is not an alternative to NSCTT. SSCTT is rather an imperative to complement NSCTT in order to promote the flow of climate technology to developing countries.

CHAPTER 6 GAUGING THE EFFECTIVENESS OF TECHNOLOGICAL COOPERATION FOR ENHANCING CLIMATE TECHNOLOGY TRANSFER AT THE FIRM LEVEL

6.1 INTRODUCTION

6.1.1 BACKGROUND

This chapter of the thesis examines effectiveness of North-South (NSCTT), South-South (SSCTT) and North-South-South (NSSCTT)¹ climate technology transfer through the prisms of a firm's ability to access information and their ability to utilize knowledge obtained from external sources. The chapter will compare these three modalities of cooperation, and gauges their effectiveness for enhancing technology transfer at the firm level. It will investigate the effectiveness of climate technology transfer at the firm level in terms of the distinct and combined effects of firm's network and absorptive capacity for climate technology transfer.

A combination of actor-network theory (ANT) and the theory of absorptive capacity (TAC) are employed as the overarching theories to examine the effectiveness of technology transfer at the firm level. The combination of these two perspectives accentuates issues of information access and assimilation. Explaining this, Davenport and Prusak (2000) point out that that technology transfer at the firm level is influenced by a firm's ability to access information and their ability to value, assimilate and utilize external information. The two most important factors for measuring the effectiveness of technology transfer at the firm level are (1) the nature of network alignments and interaction that are crucial for access to information or simply external knowledge; and (2) the knowledge base of firms or absorptive capacity to assimilate and apply the external knowledge (Nieto and Quevedo 2005; Lin et al. 2002; Law and Callon 1992, 1994).

Technology transfer, as mentioned in Chapter 2, is affected by learning system factors such as environment, industry and organization, however, access to information and ability to utilize external information have distinct and important roles for effective technology transfer at the firm level. The interplay of the two factors (access to information and ability to utilize external information) should be taken into account to understand the effectiveness of firm

¹ Unlike the other chapters, this chapter of the thesis examines NSSCTT in addition to NSCTT and SSCTT. NSSCTT for this thesis means a process whereby technology from one or more global north and south countries transfer to a southern country (for this chapter Ethiopia was considered as the host country). This understanding of NSSCTT is different from what is called Triangular cooperation, which is a process of technology transfer from a southern country to another southern country while a third actor (another country from the north or a multilateral organization) may be able to provide additional capacity to support the process.

level technology transfer. Access to information and the potential for learning are used to compare the three modes of cooperation (SSC, NSC and NSSC) when necessary and gauge their performance and effectiveness for enhancing climate technology transfer at the firm level.

The three modes of cooperation showed distinct characteristics and result in a dissimilar level of effectiveness in technology transfer. Technological capacities have occurred in all the three modes of cooperation but at different levels. Key findings from the research analysis showed the complementarity nature of NSCTT and SSCTT and ratified NSSCTT as one important way of strengthening the effectiveness of this complementarity and fostering technology transfer by leveraging the best features of NSCTT and SSCTT.

As a continuation of Chapter 5, this part of thesis also reports research conducted in Ethiopia and analyses both the nature of the country as a host for technology transfer, and the role of other developing countries as sources, and not only as recipients, of international technology innovations.

SIGNIFICANCE OF THE CHAPTER AND RESEARCH QUESTIONS

This chapter compares and contrasts SSCTT, NSCTT and NSSCTT by examining the characteristics of networks, quality relationship of actors, performance of actors networks and the critical factors of a firm's ability to value new external knowledge, including a firm's routines to interpret and understand the knowledge obtained from external sources, the internalization of new external information and ability to utilize external knowledge.

The contribution of this chapter of the thesis is threefold: 1) Chapters 4 and 5 revealed that the concept of South-South solidarity is strongly represented in the international climate regime, policy documents and official cooperation agreements. Yet the reality of this solidarity for technology transfer can be assessed by its effectiveness at the firm level. This chapter provides information on the effectiveness of this modality of cooperation for climate technology transfer by comparing and contrasting alignments and misalignments in north-south cooperation (NSC), south-south cooperation (SSC) and north-south-south cooperation (NSSC) for climate technology transfer; 2) based on the results of the technology transfer performance analysis, it provides insights about the level of technological capability gained from external information and learning through alliances; 3) the information on the characteristics, performance and relationship quality would facilitate the understanding of the correlation between the asymmetry in parties' interests at the international climate regime

(discussed in Chapter 4), national strategies for international cooperation to enhance climate technology transfer (discussed in Chapter 5) and firm level climate technology transfer.

This part of the PHD study is guided by the following research question:

How effective are the international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing the transfer of climate technologies at the firm level?

Based on this overarching question the specific research sub questions are:

- i. How are network relationships characterized, and how are networks tied up and stabilized in SSCTT, NSCTT and NSSCTT?
- ii. How is absorptive capacity and technological learning characterized in SSCTT, NSCTT and NSSCTT?
- iii. What are the challenges and benefits of the three modalities of cooperation for enhancing effective climate technology transfer, and how could the challenges be overcome?

6.1.2 METHODOLOGY

A case study method was used to gather and analyze relevant data. Three projects in Ethiopia were selected as case studies to study climate technology transfer as an emerging phenomenon and assess the effectiveness of technology cooperation modalities in promoting it.

The empirical material gathered for this chapter includes direct observation, interviews (formal and informal), reviewing relevant published material and the study of documentation available in the various international and local enterprises involved.

The author had access to daily operation of the selected case studies during the data collection period of the thesis fieldwork (from February 07, 2011 to April 27, 2011 and September 12 -27, 2011) in Ethiopia to distribute questionnaires and conduct interviews. Questionnaires were developed both in English and Amharic, the Ethiopian official language. A pilot test was undertaken with six selected respondents. Data collection was supported by direct observational evidence of actors, institutional context, and processes. For each interview a script was used to conduct the dialog and to achieve the pre-defined lines of action. Concerning sources for data collection, Yin argues that a case study approach needs to be understood as a comprehensive research method which deals with a range of different sources of evidence, for example interviews, documents, surveys, observations, etc. (Yin 1994). There are different sampling strategies with different logistics of each approach,

depending on the overall purpose of each strategy. The reason for this is that actors were selected due to their specific purposes and characteristics.

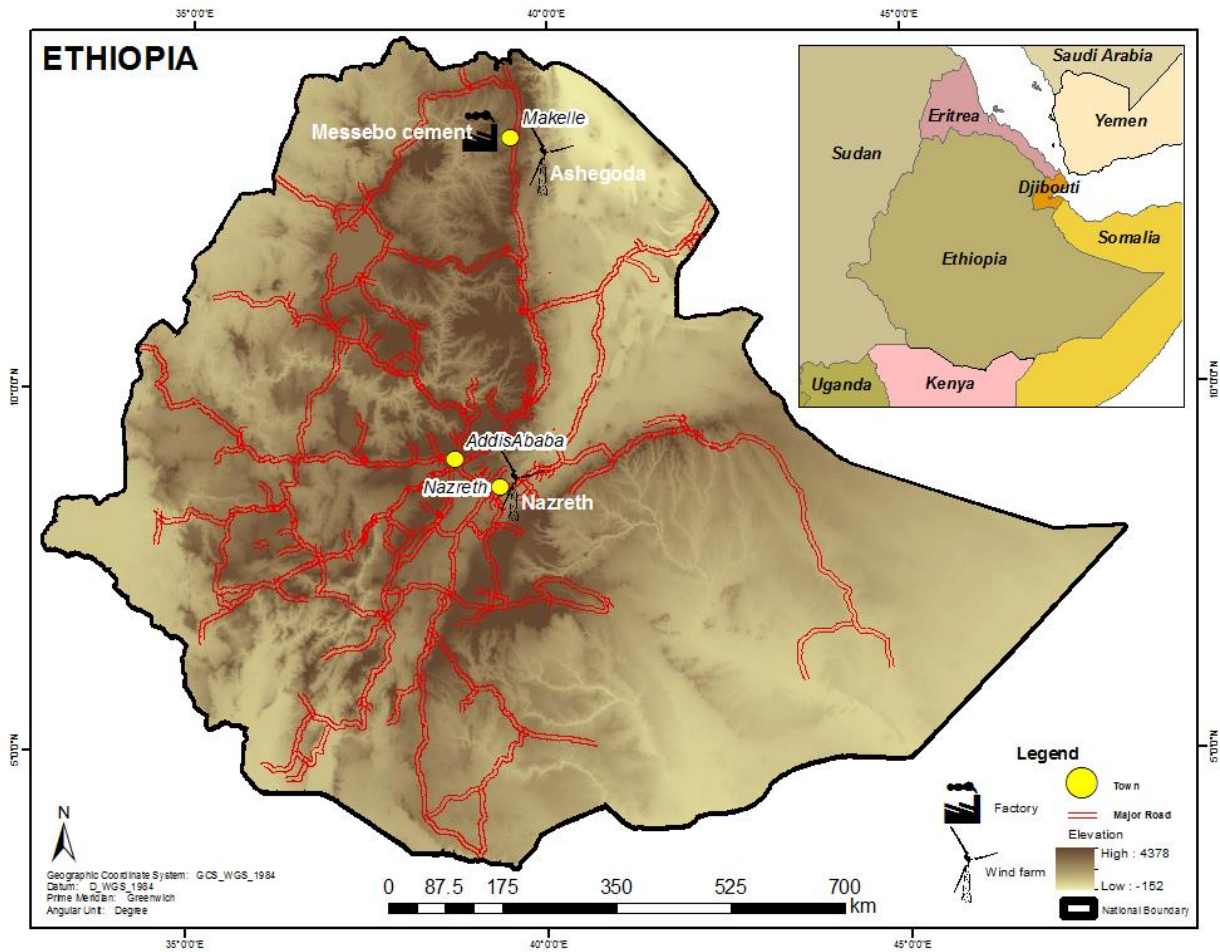
Three case studies that involved a large set of actors both from the global south and industrialized world were selected. The selection of the case studies considered: (1) the need to compare and contrast the effectiveness of the three major modes of international cooperation (SSCTT, NSCTT and NSSCTT) for enhancing the transfer of climate technologies, (2) the necessity to find and build linkages between the three modalities of cooperation, (3) the idea to feature the complex political economy of climate technology transfer and (4) the interest to shed light on the various channels of technology transfer.

The selection of the case studies was based on the information obtained from the national assessment on climate technology transfer, which was also used in the fifth chapter of the thesis. The objective of the assessment was to solicit preliminary information about the different initiatives and projects relating to climate technology transfer in Ethiopia. The assessment, which was conducted between October 8 to December 10, 2010 enabled the researcher to examine different options for the selection of the case studies that qualify typical cases for each group of technology cooperation modalities (NSCTT, SSCTT and NSSCTT). It was also during the assessment period that the type and nature of the evidence to gather, and analysis techniques to be used with the data to answer the research questions, were determined. During the month of March 2011 preliminary information was collected around the list of firms, projects and initiatives that were identified in the assessment process. Finally, in the first week of April 2011, three case studies were selected through observation, and data were collected during the second and third week of April and throughout the month of May 2011. Initial analysis was conducted on June and July 2011 and the result of the analysis necessitated the need to collect additional data. As a result, the researcher went back to Ethiopia and re-interviewed key respondents, conducted supplemental observation and collected additional project documents between September 12 -27, 2011 to improve the likelihood of accurate and reliable findings and verify key observations.

The selected case studies were:

1. Messebo Building Material Share Company (Messebo);
2. Ashegoda Wind Energy Project (Ashegoda) and;
3. Nazreth Wind Energy Project (Nazreth).

FIGURE 6.1 LOCATION OF THE CASE STUDIES



Messebo manufactures cement using low carbon technology, energy efficiency, and emission control mechanisms, whereas the latter two case studies were the first wind farms to operate in Ethiopia. Messebo is owned by the governing-party-affiliated holding company and features North-South-South Climate Technology Transfer (NSSCTT). Ashegoda wind farm is owned by the government of Ethiopia and featured North-South Climate Technology Transfer (NSCTT); whereas Nazret wind farm, also owned by the government, featured South-South Climate Technology Transfer (SSCTT). The first case study belongs to a processing industry (Cement Production) whereas the last two case studies are from the same industry sector: renewable energy. The two different industries, cement processing and wind energy sector, have been selected to exemplify climate technology transfer in different sectors whereas the strategic identification of the last two case studies from the same industry followed the interest of the research work to compare and contrast the effectiveness of SSCTT and NSCTT. ANT recognizes that industries are not homogeneous; rather within the same industry, some firms are more alike than others (Nohria and Garcia-Pont 1991). In

order to make an investigation on the differences that exist among the three different cooperation modalities (SSC, NSC and NSSC) for climate technology transfer, the strategic selection of the case studies considered similarities in firm scale, ownership, similarity of products and services, similarity in technology, among other dimensions but differences in alliances.

TABLE 6.1 SELECTED CASE STUDIES

	Messebo	Ashegoda	Nazreth
Cooperation Modality	NSSC	NSC	SSC
Owner	Government ² (Governing political party)	Government	Government
Sector	Manufacturing (Sustainable Product, energy efficiency)	Renewable energy	Renewable energy
Firm Scale ³	Large-sized (600 workers)	Large-sized (450 workers)	Large-sized (800 workers)
Technology level	High-tech	High-tech	High-tech

This chapter of the thesis is organized in four sections. This section presents a brief background of the chapter, methods of the research including description of the selected case studies and overarching theories. The second section assesses the effectiveness of technology transfer using ANT. It examines the context embedded within the alliance in order to augment the understanding of what leads to technology transfer. The third section examines the ability of the local networks in each of the case studies to value, assimilate, and utilize the technological information made available by the foreign networks. The fourth and the last section presents the conclusion of the analysis of climate technology transfer effectiveness using the combination of ANT and TAC.

BRIEF DESCRIPTION OF THE CASE STUDIES

MESSEBO CEMENT FACTORY (MESSEBO)

Messebo Cement Factory, owned by Endowment Fund for the Rehabilitation of Tigray (EFFORT) a major governing-party- affiliated holding company, was established in 1996 and production started in April 2000. The manufacturing plant is located in the outskirts of

² Even though Messebo is actually owned by the governing political party, in the current Ethiopian situation there is little difference between the government and governing political party (Zerihun 2008).

³ The International Financial Corporation (IFC) defines large companies as registered businesses with higher than 300 employees (IFC 2012).

Mekelle, a town 783 km from the capital (Addis Ababa). The processing plant is located close to its sources of raw materials. The factory uses limestone, iron ore, gypsum, and sandstone; and these are found within 40 km of the production site. The cement factory was established with an initial capital of about \$154 million and is one of the two largest cement producers in the country. It has an annual production capacity of 630,000 tonnes, a market share of 30% and a total labour force of 600. Messebo is less profitable compared with its competitor, Mughher cement factory, which has similar production capacity.

At establishment, Messebo had a large number of expatriates, particularly from Denmark, Turkey, India, Pakistan, who managed production, quality control and maintenance. The machines and equipment for the plant were supplied by M/S F.L. Smidth, Denmark, one of the most renowned manufacturers of cement plants in the world. The civil and structural works, supply and installation of the structural steel, and the entire mechanical erection works were done by ENKA construction & industry co. inc, a Turkish construction conglomerate based in Istanbul. A Chinese state owned enterprise, National Materials Company (CNMC), a subsidiary of China National Materials Group Corporation (Sinoma) was contracted in 1999 to manage the Messebo Cement factory, but the contract was terminated in 2002, and in 2003 a Pakistani company, Cementech International, was contracted and managed the factory from February 2003 until November 2009.

ASHEGODA I WIND FARM

Ashegoda I wind farm was the first of three phases of the 120 MW wind farm located 20km southwest of Mekelle, Tigray Regional State, and 763km north of the capital, Addis Ababa. Ashegoda wind consists of two main areas; the western area is located on two low ridges in an approximately north-south orientation while the eastern area is spread over a more distinct mountain range in north-south orientation with several branches. In between the two areas a lower plain area can be found. Ashegoda I wind farm is located in the Western slopes of the ridges at an altitude of 2400m above the sea level close to the descent to the coastal plain.

Ashegoda I wind farm was contracted to Vergnet Groupe by the Ethiopian Electric Power Corporation (EEPCo). Vergnet Group is a French turbine manufacturer and wind farm developer and its subsidiaries conduct complementary activities including design, production, R&D, turbine construction, and after-sales service. Through a soft loan, the French banks and Agence France de Development (AFD) financed the 210 million euro project. Vergnet Groupe uses a patented tilting rotor on its GEV-HP 1 MW turbines and the actors in the work believed the company's twin-blade machines are good for installation in rugged areas like Ashegoda because they do not require heavy lifting equipment. The German company,

Lahmeyer International GmbH (LI), supervised the wind farm construction, installation and commissioning activities on behalf of the owner, EEPCo. The wind farm consists of 30 Vergnet GEV-HP 1 MW turbines and 54 Alstom 1.62 MW wind turbines located at the Ashegoda site in the north of Ethiopia. There were three hundred people employed on the Ashegoda project, forty of them were from France, Germany, Sudan and South Africa and the rest were locals. Ashegoda I began operation on May, 2012.

NAZRETH I WIND POWER PROJECT

Nazreth I Wind Power project is the first phase of the three phased 153 MW wind farm located just outside the city of Nazareth, which is 95km to the southwest of Addis Ababa. This was one of the six Ethiopia wind projects launched in 2009 but was the first wind power project put into operation in the country. The Nazreth wind farm is located at an altitude range of 1836 - 1926 m.asl (above sea level). The feasibility study including environmental impact assessment, and financial proposal made by GIZ TERNA in 2006 indicates Nazareth Wind Farm has higher annual full load hours compared to the six other sites studied.

China's Exim Bank lent 85% of the \$117 million investment, with the remainder coming from the Ethiopian government. The EPC (engineering, procurement and construction) of the Nazreth wind farm comprises direct-drive permanent magnet wind turbines, a substation, cabling (to connect the wind turbines and substation to the electricity grid), wind monitoring equipment and temporary and permanent access tracks. The project adopts Chinese standards in design, construction and acceptance inspection; and it also uses Chinese wind turbines and employed Chinese project supervisors. It is the first Chinese wind power project to step onto the global stage in all aspects, namely, technology, standards, management, finance and equipment. In short, it is the first EPC international wind power project for China. The wind power equipment was supplied and installed by China state-owned Xinjiang Goldwind Science & Technology Co., Ltd. ("Goldwind"), which is the fifth-largest wind turbine manufacturer in the world. This is the first project for Goldwind in Africa. The construction activities of the wind farm were undertaken by a Chinese joint venture comprising two state owned companies namely HydroChina International Engineering Company (HCIE) and Chinese construction group (CGCOC). The Ethiopia state owned university, the Addis Ababa University Faculty of Technology, was the consultant in the project. It supervised the implementation of the project within the estimated time and on behalf of the Employer. The consultant was responsible for all clarifications, approvals of detailed designs, testing procedures and certificates. There were 600 Ethiopians and 200 Chinese workers in the project, i.e. the China: local ratio was 0.33 which was much higher than the Ashegoda wind farm where the French: local ratio, was 0.062. In Ashegoda, there were 400 Ethiopians, 25

French and 25 other nationalities including from Germany, Sudan and South Africa. The Nazreth wind farm started operating in June 2011 and has 34 1.5MV wind turbine generating systems (WTGS) with a total installed capacity of 51MW.

EXAMINING THE EFFECTIVENESS OF TECHNOLOGY TRANSFER: OVERARCHING THEORIES

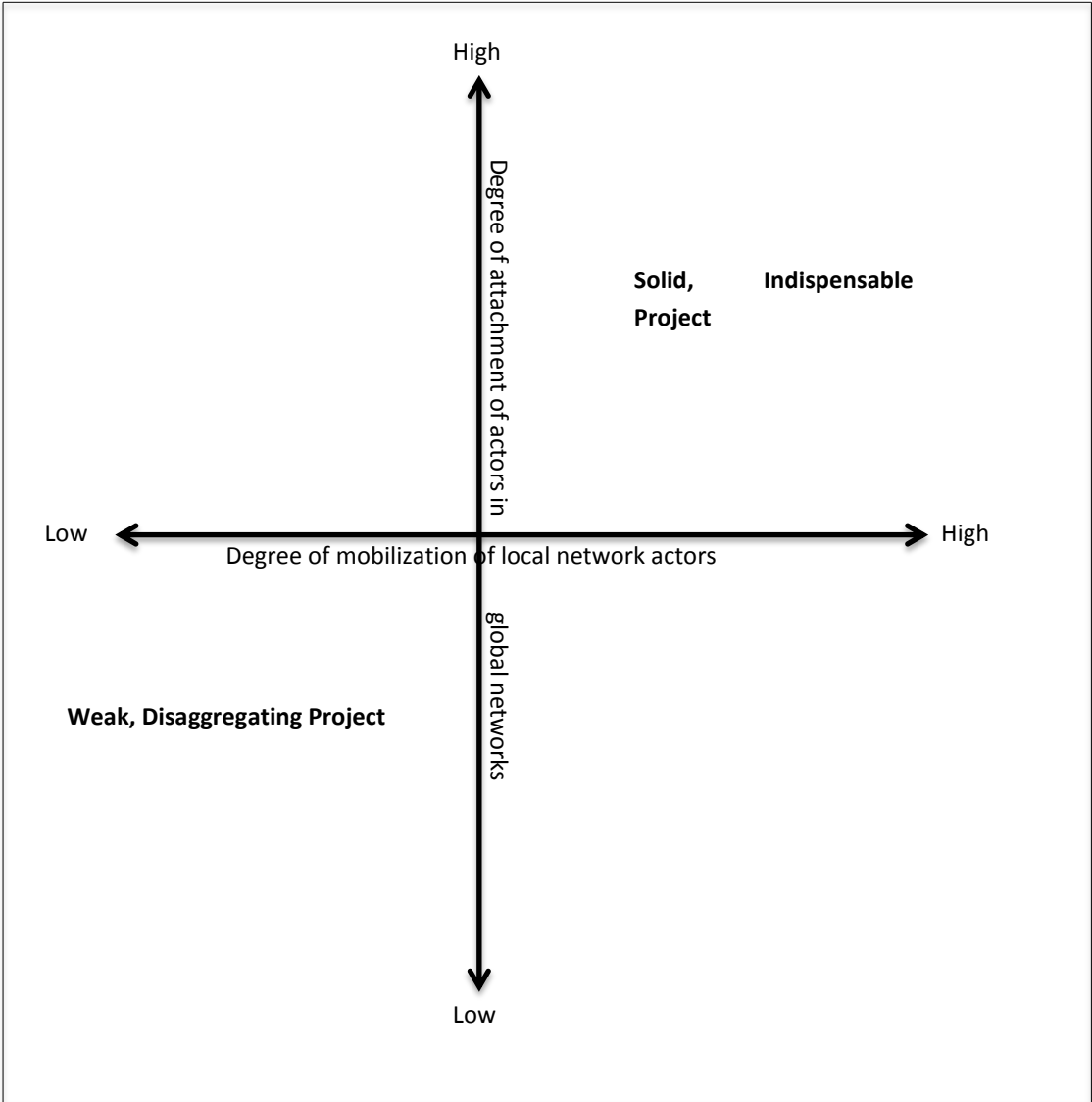
A combination of actor-network theory (ANT) and the theory of absorptive capacity (TAC) are employed as the overarching theories to examine the effectiveness of technology transfer at the firm level. In this chapter of the thesis, analysis of the case studies using ANT as a framework highlights the importance of access to information for technology transfer, whereas TAC centers on examining actors' abilities to integrate the information and knowledge into their processes and routines.

ANT enables the analysis to bring the actors together in ways that facilitate a productive exchange of relevant information and knowledge to understand people and technology changes and produce new knowledge. It explains that actors undergo some adaptation to use the technology; and they may make adjustments to suite the characteristics of the actors. However, although it is called a "theory", ANT does not usually provide explanations "why" or "how" actors assimilate, change or undergo some adaptations to use the technology. As Latour notes (1999 and 2005) "explanation does not follow from description; it is description taken that much further" and "ANT does not usually explain "why" or "how" a network takes the form that it does". On the other hand TAC explains "why" or "how" actors assimilate (Zahra and George 2002) and incorporate externally generated technical knowledge into the firm (Mowery and Oxley 1995).

Therefore, in this thesis ANT and TAC are used in a way that they can complement each other in order to explain the effectiveness of the international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing the transfer of climate technologies at the firm level. One of the criticisms of ANT used as analytical framework is that it is highly descriptive, telling stories about 'how' relations assemble or don't (Law 2007). In order to mitigate this limitation of ANT, in this thesis a two-step ANT analysis is employed: the first part focuses on describing the process of actor's interaction followed by a second step, which is plotting the interaction of the actors on a two dimensional graph to measure the degree of mobilization of actors. This two-step approach coupled with the employment of TAC make the analysis explanatory and provides accounts of the effectiveness of the international cooperation modalities for climate technology transfer.

Actor Network Theory (ANT) claims that technology transfer processes evolve over time and that people and their networks change with time. These changes (actors' negotiations) represent the positive and negative network alignments, with technology transfer becoming the result of these interactions (Law and Callon 1992). Law and Callon (1992) contend that it is the degree and form of mobilization of the global and the local networks, and the way in which they are connected, that determines success of a project in reaching its set goals. They suggested that it is possible to plot the interaction of the local-global networks of any project (Figure 6.2) on a two-dimensional graph where the x-axis measures the degree of mobilization of local actors (control over the local network) and the y-axis the extent to which global actors are linked (control over the global network).

FIGURE 6.2 LAW AND CALLON (1992) NETWORK ANALYSIS



The theory of absorptive capacity (TAC) examines a firm's ability to recognize the value of new, external knowledge, assimilate it, and apply it to commercial ends (Lane and Lubatkin 1998). The premise of the notion of absorptive capacity is that the organization needs prior related knowledge to assimilate and use new knowledge (Kim 1991). Sazali et al. (2009) proposed a model for measuring absorptive capacity using six important variables which include: (1) academic background, (2) technical capacity, (3) educational programmes, (4) financial support, (5) overseas training opportunities, and (6) commitment.

The Ethiopian networks ability to value, assimilate, and utilize external information is an important aspect of the network quality for effective technology transfer. A company's absorptive capacity is the enabling quality for converting knowledge into new products, services or processes to support innovation (Zahra and George 2002). To identify which aspects of absorptive capacity matter more in the selected case studies, a survey was conducted. Survey questions were distributed by email and in person between February 07 to April 27, 2011. In the survey, 105 Messebo, and 34 EEPCo employees were involved. Messebo and EEPCo are the two major actors in the local networks. The survey included EEPCo staff that were involved in the Ashegoda and Nazreth projects, and located both in the project sites and the project offices in Addis Ababa, EEPCo headquarters. The survey didn't include the local subcontractors, who worked in the project for a relatively brief period of time. The survey participants in the two organizations (Messebo and EEPCo) were selected based on the diversity of their positions and educational backgrounds. Engineers, mechanics, marketing specialists, and human resource administrators from expert to management committee members were included. In addition, two senior managers from Vergnet, three from HydoChina and three from EFFORT were interviewed for comparative analysis.

6.2 ANALYZING TECHNOLOGY TRANSFER USING ANT

6.2.1 TRANSLATION PROCESSES AND THE CASE STUDIES

The translation process employed in this thesis refers to the processes of negotiation, representation and displacement between actors, entities and places (Murdoch 2001). In each of the case studies four major moments of a translation process (Problematization, Interessement, Enrolment and Mobilization) were used to analyze the manner in which actors form associations with other actors; and the process through which actor-networks are established and stabilized. However, as Woods (1997) argued the moments may in reality overlap. In the first moment – problematization, a group of actors identifies the problem to be solved or defines an issue as problematic (Verschoor 1997). The second moment – 'interessement' – is characterized by getting the actors interested, negotiating the terms of

their involvement and consists on the deployment of devices aimed to impose the roles and identities addressed during problematisation (Verschoor 1997). Enrolment, the third moment, is the processes in which actors are persuaded or obliged to play particular roles within the network characterize this step (Hillier 2002). If enrolment has been achieved, then comes mobilization, the fourth moment, of the network of entities involved in which the actors in the network adequately represent the masses.

ANT TRANSLATION PROCESS IN MESSEBO CEMENT FACTORY

Addis Engineering Consultancy PLC, another EFFORT subsidiary company, was tasked by EFFORT to conduct a feasibility study on the production of cement on the outskirts of Makelle city in mid 1990s. Addis Engineering contacted many internationally renowned companies including M/S F.L. Smidth, Denmark for information and advice on the potential of the cement production. Finally, based on the feasibility study report findings and recommendations a decision was reached by EFFORT board to establish Messebo at the time when EFFORT was evaluating viable investment opportunities. The availability of raw materials, production capacity, type of cement to be produced and the types of technology to be purchased were decided with the involvement of both local and international experts with the leadership of Addis Engineering. In ANT terms, this was the moment of problematisation.

The network interessement was achieved through tenders, negotiations and contracts, which aimed to impose the roles and identities of the different actors including machine suppliers, construction companies, consultants and other companies. After the moment of problematisation, Addis Engineering came out with the role of consultant for the civil and structural works, supply and installation of the structural steel and the entire mechanical erection works of the project. However, Addis Engineering had limitations in experiences and skills to perform its consultant roles. In order to overcome its capacity limitations, it subcontracted Haltach Consultancy Co, an Indian company based in New Delhi, for the technical work of the consultant work while Addis Engineering focused mainly on administrative activities, and in particular served as a liaison between the employer and other actors. M/S F.L. Smidth, Denmark for machine supply and ENKA construction & industry co. inc for mechanical and civil works were identified. The management of Messebo cement from the start of commissioning was given to the Chinese company, CNMC, without going through a tender process.

The problem with the network initial alignment began at the second translation moment (enrolment). The advantage of the ideological proximity between CNMC and EFFORT was now causing disruption in the network relations with the enrolment and mobilization being forced by the EFFORT management. The Chinese expatriates had a problem of

understanding the operational manuals, which were written in English, and had difficulties communicating with local staff and supplier representatives. Moreover, they were unfamiliar with the F.L. Smidth cement technologies (Interview with Kasim Sirag on May 22, 2011).

The lack of trust between the F.L. Smidth and Chinese expatriates was another problem. F.L. Smidth expatriates were collaborative in terms of information sharing and joint problem solving with Messebo local staff only when the Chinese were not around. At the same time, the Chinese expatriates were not committed to work with F.L. Smidth expatriates (Interview with Dires Mekonnen on May 22, 2011). In 2001 the plant was running at heavy losses and there was talk of foreclosure.

TABLE 6.2 MESSEBO ACTOR-NETWORKS DESCRIPTION

Actors	Intern./Local	Role
Endowment Fund for the Rehabilitation of Tigray (EFFORT)	Local	Owner and employer: Overall strategic manager of the company
Addis Engineering Consultancy PLC	Local	Consultant: represented the employer and supervised the work of the construction company
Haltach Consultancy Co,	Int./India	Subcontracted Consultant: supervised the work of the construction company
M/S F.L. Smidth	Int./Denmark	Manufacturer and supplier: manufactured and supplied Messebo machines and equipment.
ENKA construction & industry co. inc	Int./Turkey	Construction company: civil and structural works and installation of the structural steel and the entire mechanical erection works of the project
China National Materials Company (CNMC)	Int./China	Contractor: managed Messebo operation and maintenance from 1999 -2002
Messebo Cement company local staff	Local	Employees: operate and managed Messebo cement plant
Cementech International	Int./Pakistan	Contractor: managed Messebo operation and maintenance from 2003 -2009
Tigray youth co-operatives and mass associations	Local	Local retailers: distribute Messebo cement in Tigray region
TransEthiopia P.L.C	Local	Transport company: transport Messebo cement from plant premise to distribution areas
Guna Trading House PLC	Local	Wholesale trading company: national wholesaler for the Messebo product.

The terms of reference of CNMC were renegotiated more than three times but the problem was not solved. As a result, the Chinese management contract was terminated in 2002. The preference for an ideological rather than a commercial set up of EFFORT, was causing another problem in terms of playing its employer role effectively. The Board members of

EFFORT were senior members of the governing political party, EPRDF, and during the Ethiopia and Eritrea war (from May 1998 to June 2000) they were engaged in party and government duties and were almost totally absent from their EFFORT activities. They were not readily available for immediate and strategic decisions (Interview with Abraham G.Medhin on May 24, 2011).

As a result, the networks among the actors were poorly connected, that is, the connections did not hold in the face of adversity. The network was close to falling apart without producing major relevant outputs. In 2003, after the war, EFFORT conducted a major reshuffling in its board members, hired large number of local Messebo staff including senior managers, and replaced the Chinese expatriates by Pakistanis (Cementech International).

There was frustration and friction between the more ideological EFFORT board and the more professional management of the Messebo senior local managers. The divergence between commercial decision-making (Messebo senior local managers) and the demands of the wider political rationale (EFFORT board) was became more evident at the time when Messebo entered into a series of controversial wholesale deals for cement distribution within Tigray with governing-party affiliated associations and organizations such as youth co-operatives and mass associations, which are allowed to benefit from local monopolies such as cement retailers. The Messebo management along with private and construction sector critics complained that the local wholesale deals drove up prices and hurt Messebo's long-term competitiveness (Interview with Kalimullah Bilwal on May 21, 2011, Kasim Sirag on May 22, 2011, and Dires Mekonnen May 22, 2011).

In addition, EFFORT subsidiaries enjoyed exclusive national transportation and distribution, and they sustained a series of semi-monopolistic or transfer rents. The national distribution and transport of Mesebo's cement was monopolized by an EFFORT transport subsidiary called TransEthiopia P.L.C and wholesale trading subsidiary, Guna Trading House PLC. TransEthiopia charged USD 6 per quintal for transporting the Messebo product from the factory site to Addis Ababa, as compared with a market rate closer to USD 3-4. Messebo management complained that these ideological factors made Messebo less profitable compared with its competitor Mughher Cement PLC. Despite the frictions and tensions, the EFFORT board and Messebo management maintained their institutional link.

The institutional connections of Messebo local staff, INKA, F.L.Smith, Addis Engineering, Haltach Consultancy Co and Cementech International was relatively well maintained and the network was in good health (Telephone Interview with Mikkel Sørensen on May 26, 2011, Interview with Miao Huang on May 23, 2011, Fikru Hagos on May 23, 2011 and Berker Demir May 26, 2011 and September 13, 2011). As a result, the actors were

mobilized and this enabled local experts to become acquainted with the latest production and quality control technologies. This also allowed the company to produce products, as certified by different agencies, that were well above the minimum requirement of the Ethiopian Standards Agency for Portland Cement. The local experts, based on the knowledge gained from FL.Smith expatriates, successfully introduced a new and environmentally friendly product called Portland Limestone Cement (PLC), which is useful in finishing and plastering.

The ingredients of PLC require lower heat to burn, thereby saving on the cost of fuel. The introduction of PLC since 2005 also reduced the use of large amount of Pozollana ash, which is transported from an area located 100 km away from the factory, whereas limestone is available just 1.3 km away from the plant.

In 2009, the local Messebo experts, with the help from Cementech International, undertook a production process re-engineering exercise and replaced the Sudanese imported furnace oil it had been using, with 10% Delbi coal (mined in Ethiopia) and 90% petcoke (a byproduct of oil, imported from Sudan), thus reducing costs. This success created a new relationship and alignment between Messebo and Cementech International in the network. The two companies established a coal-mining company in a joint venture.

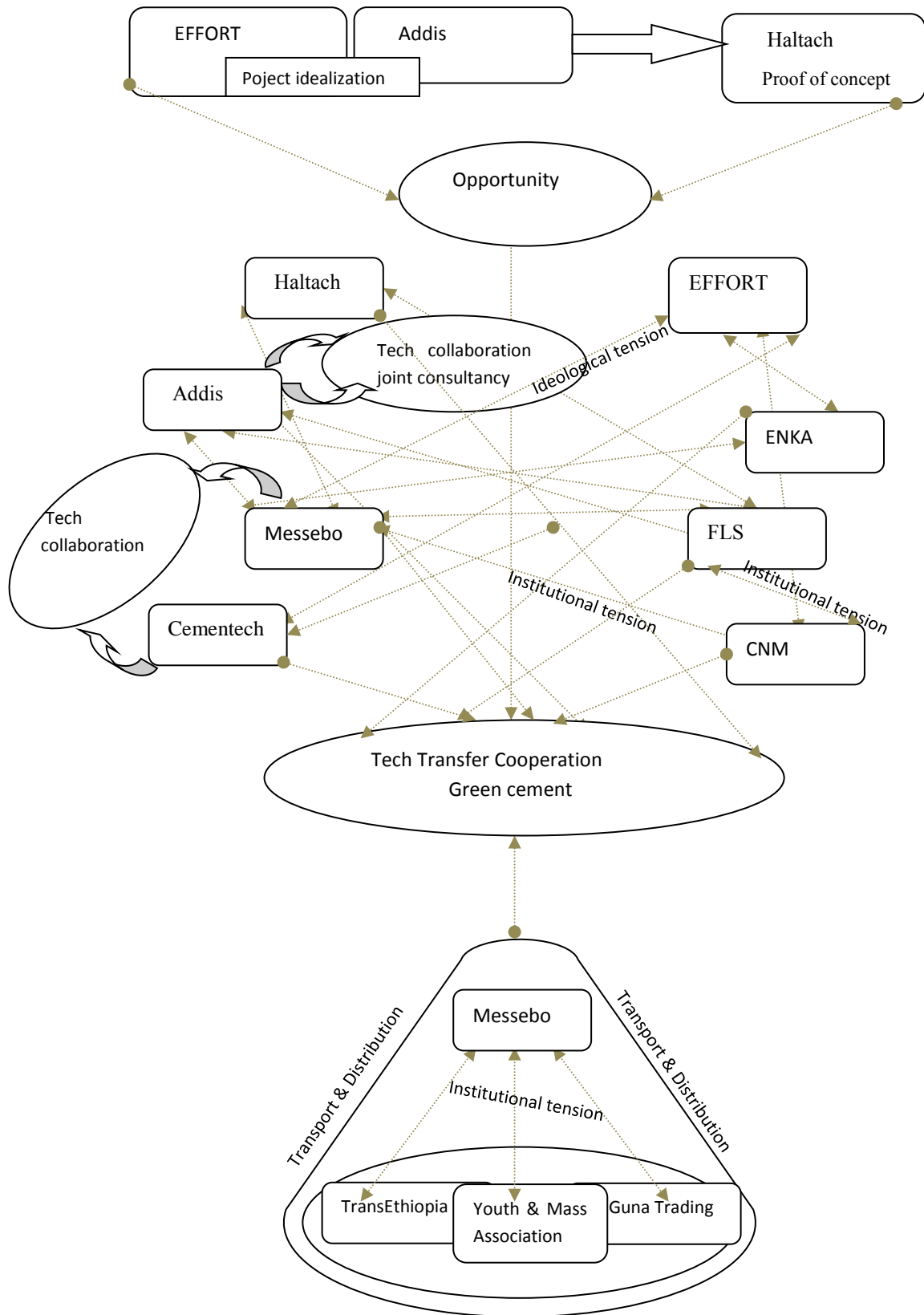
Messebo in 2012 was operated by local experts at 140% design capacity, producing about 900,000 tonnes of Portland Cement per annum, and became the only plant in the country producing environmentally friendly cement as a result of the technological competencies of the local networks. By the end of 2011, Messebo had an average turnover of about \$83 million, and net profits of \$25 million. The ANT analysis was put together in a systematic diagram (see Figure 6.2) where the density of the network was indicated on the number of connections and other features such as institutional frictions are also featured.

TRANSLATION PROCESS OF THE WIND FARM CASE STUDIES

INTRODUCTION

Ethiopia's considers itself as "emerging renewable energy powerhouse of Africa". It ranks second in Africa in terms of hydropower potential, after the Democratic Republic of Congo, and exports significant amounts of electricity to its East African neighbors. As part of Ethiopia's ambitious \$150 billion, 20-year green growth strategy (GGS), diesel power stations will be replaced by hydro, solar, geothermal and wind energy by 2015. The renewable energy projects are part of Ethiopian Electric Power Corporation's (EEPCo) plans to increase national electricity generation capacity five times by 2015, from 2000 megawatts (in 2010) to about 10,000 MW.

FIGURE 6.3 MESSEBO TRANSLATION PROCESS DIAGRAM



In the context of the Ethiopian power system, wind power will play a vital complementary role with hydro power in that the natural cycle of wind energy availability is such that it increases in the dry season when the hydropower reservoirs are low, and decreases in the wet seasons when the reservoirs are rapidly filling with water. This will make wind power a crucial ingredient to the grid energy mix by improving the reliability of the system even in dry years. The Government of Ethiopia (GoE) identified high investment and unit energy costs as the major obstacles to the large-scale deployment of wind power in Ethiopia.

To address this problem the GoE, in line with its strategy for the power sector as a whole, set the objective of increasing the local value added in the engineering and technological inputs going into the development of wind farms while continuously searching for concessional financing, thereby ascertaining the long term future of large scale wind power development in Ethiopia.

HydroChina International Engineering Company (HCIE) conducted a US\$1.5 million survey financed by the Chinese government in 2004, which was meant to evaluate the country's potential for a wind plant. HCIE managed the wind energy resource assessment Master Plan and Beijing Engineering Corporation undertook the implementation and design of the Master Plan. The master plan indicated that Ethiopia is endowed with a huge estimated potential of 100 GW technically feasible wind power. The current plan of the government of Ethiopia is to have around 800 MW by 2015. To this end, EEP Co has so far spotted six promising wind farm sites as main fast-track wind energy development. Table 6.3 summarizes the different wind power projects that EEP Co has planned to be developed by 2015.

TABLE 6.3 FAST-TRACK WIND ENERGY PROJECTS PLANNED TO BE DEVELOPED BY 2015

No.	Wind Project	Generating Capacity (MW)	Status (as of June 2013)
1	Ashegoda	120	Operational
2	Nazreth	153	Operational
3	Ayisha	300	Under construction
4	Assela	100	Under construction
5	Debre Birhan	100	Under negotiation

TRANSLATION PROCESS IN ASHEGODA WIND FARM PROJECT

The Ethiopia government 20 year- green growth strategy and the Hydro China Corporation US\$1.5 million survey report were the bases for the establishment of the wind park projects partnership between Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and EEPCo in the northern parts of Ethiopia. The Ashegoda site feasibility study was conducted by the Frankfurt based Lahmeyer International (LI) GmbH in 2006 with the financial support of the Austrian Development Cooperation (ADC) through its operational unit, the Austrian Development Agency (ADA) and GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). The feasibility study included wind potential analysis, conceptual technical layout, environmental impact assessment and an economic/financial analysis. The study also comprised a Capacity Credit and Clean Development Mechanism (CDM) assessments.

The collaboration of EEPCo, GIZ, ADA and IL was an incentive to technology advancements in wind energy by joining together the need for increasing the local value added in technological inputs going into the development of wind farms while helping the country achieve its development goals and limiting the 2030's GHG emissions to 2010 level. This movement of translation (problematisation) created the conditions for environmental technology transfer.

The interessement moment of the translation process begun in 2008 when EEPCO awarded contracts to French manufacturer of small turbines, Vergnet Groupe (the turbine manufacturer and EPC contractor) and IL (who supervised the construction work). Vergnet SA did the turnkey project of the farm, from design to the commissioning, at 294 million dollars. Construction commenced in October 2009, after the project obtained a loan from the French Development Agency (AFD) for 69.8% of the total projected cost. BNP-Paribas, syndicated with Societe General and CIC Bank, all of which are French banks, loaned 21.4% and the EEPCo contributed the remaining almost 9%.

The turbines and the equipment were shipped to the port of Djibouti and from there the turbines were transported to the project site by road; the main road to Mekelle passes the Ashegoda site at a distance of approximately 10 kilometres. Vergnet Groupe subcontracted a local construction company, Rama General, to upgrade roads and build infrastructure to support construction before starting work on the turbine foundations in the summer of 2010.

Rama General constructed new roads to the project site and reinforced existed access dirt roads. The transportation of the wind turbine components from Djibouti port, which is about 800 km from the project site, was a major obstacle in the project (Interview with Gédéon

TABLE 6.4 ASHEGODA ACTOR-NETWORKS DESCRIPTION

Actors	Int./Local	Role
Ethiopian Electric Power Corporation's (EEPCo)	Local	Owner and employer: Overall strategic manager of the project.
Lahmeyer International (LI)	Int./Germany	Consultant: conducted the feasibility study and supervised the work of the construction company.
Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	Int./Germany	Financial provider and Subcontracted Consultant: Financially and technically support the feasibility study and acted as engineering advisor in the project phase.
Austrian Development Agency (ADA)	Int./Austrian	Financial provider: Financially supported the feasibility study
Vergnet Group	Int./France	Manufacturer and contractor: Supplied and manufactured turbines for Ashegoda I and developed Ashegoda I & II.
French Development Agency (AFD)	Int./France	Financial lender: covered 69.8% of the total projected cost
BNP-Paribas and CIC Bank	Int./France	Financial lender: covered 21.4% of the total projected cost.
Astom Group	Int./France	Manufacturer and Sub contractor: Manufactured turbines and equipment for Ashegoda II and constructed the substation for Ashegoda I
Sarens South Africa	Regional/South Africa	Heavy lifting and mobile crane company: handled the unloading, placing and moving heavy loads during wind turbine installation.
Somarain Oriental Shipping Co. Ltd	Regional/Sudan	Transport company: transported the entire wind turbines
Rama General	Local	Construction company: Constructed roads and other civil works
Hydro Plc	Local	Geological company: participated in the geological and drilling works of the project
Sitec Ethiopia PLC	Local	Installation/erection company: participated in the electromechanically installation
SIGMA Electric PLC	Local	Installation/erection company: participated in the substation installation works

Durand May 8, 2011, and Tsehaye Mebhratu May 12, 2011). Somarain Oriental Shipping Co. Ltd, a Sudanese company, transported the entire wind turbines, which took about one and a half years using 10 separate trucks. Sarens South Africa, a South African heavy lifting and mobile crane hire group, handled the unloading, placing and installation of the wind power equipment. Vergnet Groupe successfully brought African firms to cooperate and work

together, which otherwise could not happen easily (Interviews with Abd Elmonim Artoli on May 11, 2011, Tsehaye Mebhratu May 12, 2011 and Gédéon Durand May 8, 2011).

In addition to the road construction, Vergnet also subcontracted Rama General Contractor for the rest of the civil construction work of the project. A local firm, Hydro Plc, did the drilling work and Sitec Ethiopia, another local company, participated in the electromechanical work. Sigma Electric, a local firm, together with the French engineering giant Alstom constructed the high voltage (HV) substation to connect with the Mekelle–Alamata power transmission line to enter the national grid. Modifications and mechanical adjustments were done and manufactured by Mesfin Engineering PLC, which is located in Makelle, close to the project site. In addition to subcontracting local and African firms, Vergnet had local staff at different positions such as engineers, inspectors, contract managers as well as administrative positions.

The two major actors, LI and GIZ, who participated in the feasibility study of the Ashegoda wind farm continued their involvement in the project phase as well: the German engineering consultancy Lahmeyer International obtained a construction supervision contract, while GIZ acted as an engineering advisor on the project. IL worked with EEPCCo for many years in other renewable energy projects including hydro projects and the Corporation's Universal Electric Access Programme. Even though EEPCCo engineers have been delighted working with IL because of its technical competency, the research interviews revealed that some higher officials at EEPCCo didn't fully trust IL behaviors (Interview with Alphonse Dumortier on May 8 and September 16, 2011, Abra Mulugeta May 10, 2011). They read the World Bank 2007 report where the bank found IL guilty of bribing officials responsible for lending contracts for the Lesotho Highlands Water Project. IL was barred from any World Bank project for seven years and fined \$1.63 million. The officials were afraid that EEPCCo's long years of partnership with IL could affect the effort of mobilizing funds from international financial institutes like the World Bank and other donors, at the time where the government of Ethiopia desperately needed concessional loans and other form of funds from these institutes (Interview with Abra Mulugeta September 17, 2011). The initial date for the completion of the first phase of the Ashegoda wind farm was set for February 2011, and then moved to September 2011, and finally it was completed on May 2012.

The project was delayed due to contract mobilization issues, problems with transportation, the surveying, geotechnical, and design and redesign works took longer than anticipated and also the delay from IL to provide product quality certificate (Interview with Gédéon Durand May 8, 2011, Alphonse Dumortier on May 8 and September 16, 2011, Abra Mulugeta May 10, 2011).

The contract design of the Ashegoda Wind Farm Project was altered to include turbines generating more power in the second and third phases of the project; the number of turbines went down from 90 (original plan) to 45 turbines to generate the same 90MW. As a result, the wind farm were relocated from its original planned site, the Western slopes of the ridges, to eastern area, which is a more mountainous area with more turbulent winds. The decision to increase the generation capacity of the turbines to be used in the later stages was made by EEP Co to conserve construction time.

The second and third phase each consisting of 45 MW was scheduled in the original contract to be completed within 10 months but due to the contract amendment EEP Co they were finished earlier than the original schedule. The new mountainous location of the turbines is subject to more turbulence and thus ill-suited to the Vergnet turbines. As a result, instead of its own windmills, the French company was installing 54 Alstom ECO74 1.67MW three-blade turbines in the second and third phases of the project. Phases II and III were completed in May 2013.

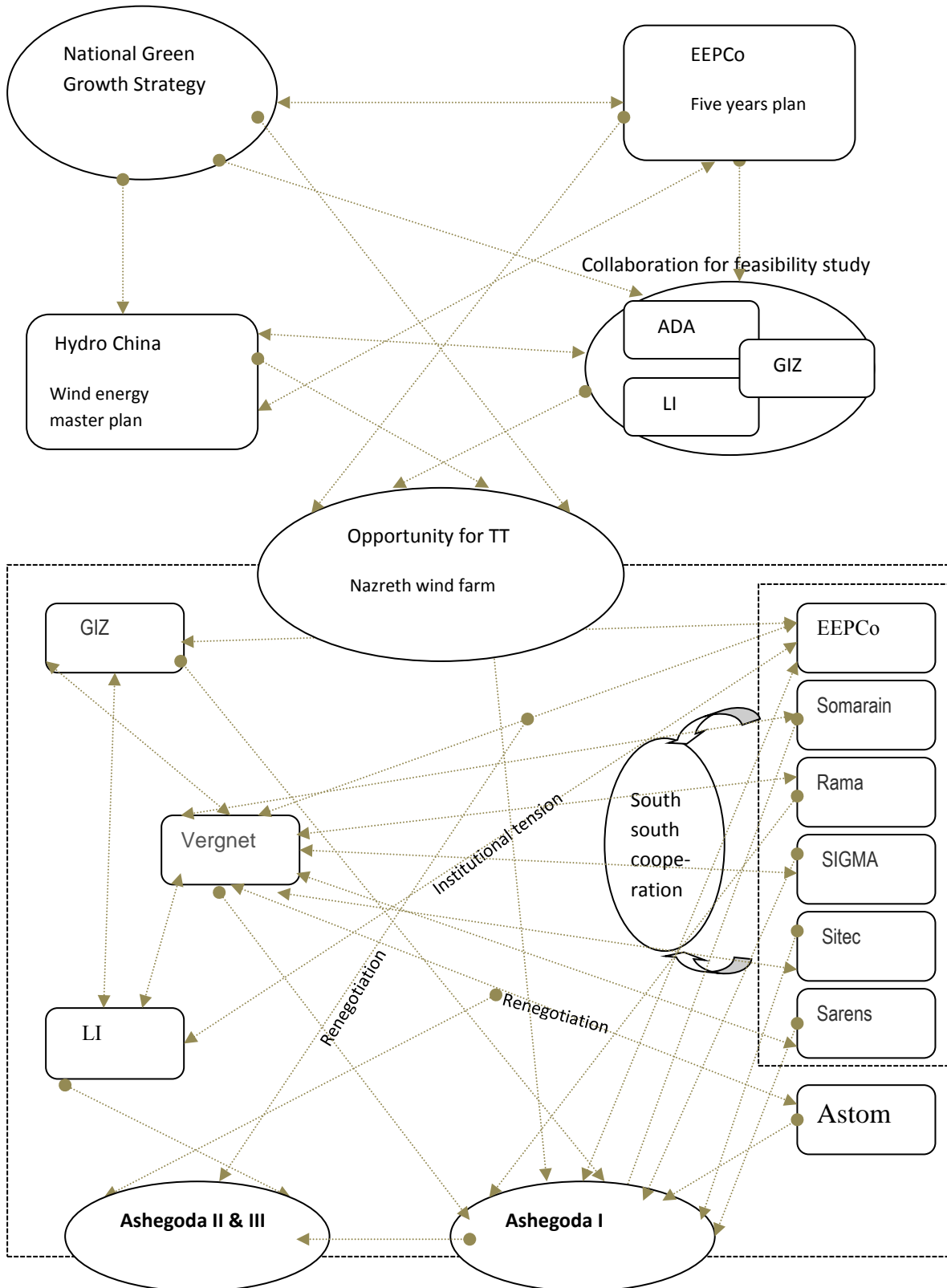
Having successfully mobilizing its local and international allies, despite the delay in finalizing the project, Vergnet started negotiating with the newly established government owned electromechanical company, Mtech Ethiopia, and HydroChina to establish an assembly plant in the short-term and a manufacturing plant in the long-term. Mtech Ethiopia is now the largest local company in electromechanical erection and commissioning. Its main objective is to bring about technology transfer, import substitution, and, eventually, export mechanical and electrical items for government led mega projects.

The ANT analysis was put together in a systematic diagram (see Figure 6.4) where the density of the network is indicated by the number of connections. Other features such as institutional frictions are also included.

TRANSLATION PROCESS IN THE NAZRETH WIND FARM PROJECT

On Sep 22nd, 2009 the Joint Corporation of HYDROCHINA Engineering Consulting Co., Ltd. (HydroChina) and CGCOC Group signed a contract with EEP Co regarding Nazret wind farm with the objective of developing 51MW wind power with 34 turbine units each of 1500kW capacity with a total installed capacity of 51MW. This translation moment (problematization) created the conditions for technology transfer. The project contract put limitations on the number of Chinese experts, demanded the contractor to hire local sub-contractors as much as possible, make available necessary documents in English, and provide training to local experts. The deal also included a five-year operation and maintenance contract.

FIGURE 6.4 ASHEGODA TRANSLATION PROCESS DIAGRAM



HydroChina undertook the electromechanical work for the Adama project while Chinese contractor CGOC was in charge of the civil work. Goldwind supplied and installed the equipment and the turbines. This project was funded through China's preferential buyer's credit by China Exim Bank. Another Chinese company, SANY Group Co. Ltd, undertook all kinds of hoisting work including unloading large-scale wind power equipment after arrival, moving heavy loads during wind turbine installation and maintenance and then placing and installing the equipment. The same company transported all equipment including the turbines from Djibouti port to the project site, which were supplied by Goldwind in three batches between March and June 2011. Addis Ababa University, the consultant, was the only local network major actor in the network.

The consultant of the project was established from a team of mechanical and electrical engineering professors at the Addis Ababa University (AAU), School of Engineering. The team approached EEPCo to take part in the wind farm construction activities in 2008 at the time when the Ethiopia government was desperately looking for a government owned local company to involve in the Nazreth project (Interview with Debella Tadele on April 29, 2011, Gebre-Hana Wolde-Senbet on May 1 and September 23, 2011). The AAU professors' team was offered the consultancy work without any kind of tender or competency evaluation. The team participated in the project under the banner of AAU but apart from their teaching staff position they didn't have any form of institutional background such as Advisory Services or any other similar set up that could maintain the knowledge gained.

All major activities including installation of the collector system, Chinese government owned companies performed design works, surveying, geotechnical, substation, transportation, and even the construction of access roads to each turbine site. There were no local engineers or other experts from the contractors' side; however, there were unskilled labors with the Chinese contractors. The locals participated in labour activities mainly as drivers for small vehicles, workshop assistances, and other similar labour.

The Chinese project consortium was continuously reorganized and regrouped without formal agreement with the employer, EEPCo. For instance, the Beijing Engineering Corporation undertook the geological and drilling activities of the project but its participation was unnoticed by the RE (resident engineer) of the EEPCo and the consultant (Interview with Zhi Peng on September 22, 2011, Gebre-Hana Wolde-Senbet on September 23, 2011). There were also other Chinese companies, which participated in the electromechanical installation and the civil construction under the banner of HydroChina and CGOC. Despite what

TABLE 6.5 NAZRETH ACTOR-NETWORKS DESCRIPTION

Actors	Int./Local	Role
Ethiopian Electric Power Corporation's (EEPCo)	Local	Owner and employer: Overall strategic manager of the project.
Addis Ababa University (AAU)	Local	Consultant: supervised the work of the construction company.
Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	Int./Germany	Technical provider: Technically supported the feasibility study.
Xinjiang Goldwind Science & Technology Co., Ltd. ("Goldwind")	Int./China	Manufacturer and Supplier: manufactured, supplied, and installed turbines and equipment.
China Exim Bank	Int./China	Financial lender: loaned a financial support covering 85pc of the total projected cost.
HYDROCHINA Engineering Consulting Co., Ltd. (HCIE)	Int./China	Contractor: Managed the installation of electromechanical and substation works.
CGCOC Group		Contractor: Managed all kinds of civil construction of the project including road construction.
SANY Group Co.,Ltd,	Int./China	Heavy lifting and mobile crane company: handled the unloading, placing, moving heavy loads during wind turbine installation and transported the entire wind turbines.

happened in the project implementation, EEPCo was strong in the Nazreth contract negotiation in particular in the area of subcontracting paragraphs. For instance, in the case of the Nazreth, the contract agreement read as "The contractor can't subcontract without the prior consent of the Employer for any part of the Work, which was not specifically allowed to subcontract". Whereas in the Ashegoda Project contract the similar paragraph read as "In the case such Subcontractor was not included in the list of Subcontractors in the Contractor's Tender, the Contractor shall notify the Employer of the details of such subcontract in the first subsequent monthly report made in accordance with."

In the project agreement, EEPCOs had tried to rise above the SSC political discourses and focused on results on the ground, nevertheless the project consortium was established based on already existed ideological relationships between the Communist Party of China (CPC) and the Ethiopia governing party, Ethiopian People's Revolutionary Democratic Front (EPRDF). The consultant, AAU, which was outside of the ideological network sometimes had a hard time to settle technical project implementation differences and find common ground with the Chinese contractors. The Chinese took issues and differences they had with the consultant to the senior managers of EEPCo.

The ideological factor coupled with the limited experience of the AAU and its unconvincing institutional set up had negative effects on the performance of the consultant (Interview with Deribew Byabil on May 2, 2011). EEPCo engineers did not seriously consider the consultant advice and recommendations. The experience of EEPCo in similar international projects was an important factor in the network stabilization and mobilization moment of the network. The strong involvement of senior managers in detailed technical issues, which could be a problem for the translation process, was in this case an advantage, as the EEPCo management had minimized the problems related to institutional tensions and reorganizations of the Chinese partners. EEPCo management organized a number of meetings with the Chinese, the consultant, and the EEPCo engineers to ensure actor alignment. It introduced different conditions for the Chinese contractors to ensure technology transfer and also stimulated local staff including the consultant to focus more on the learning aspect of the network. They made translation processes quite desirable and needed. The project consortium partners had mobilized the allies (the last moment of the translation process) and finalized the first phase of the project in time. EEPCo offered the same Chinese companies to continue their work for Nazareth II wind farm project in the same location and with the same allies.

The ANT analysis is presented in a systematic diagram (Figure 6.5) where the density of the network was indicated on the number of connections; and other features such as institutional frictions are also featured.

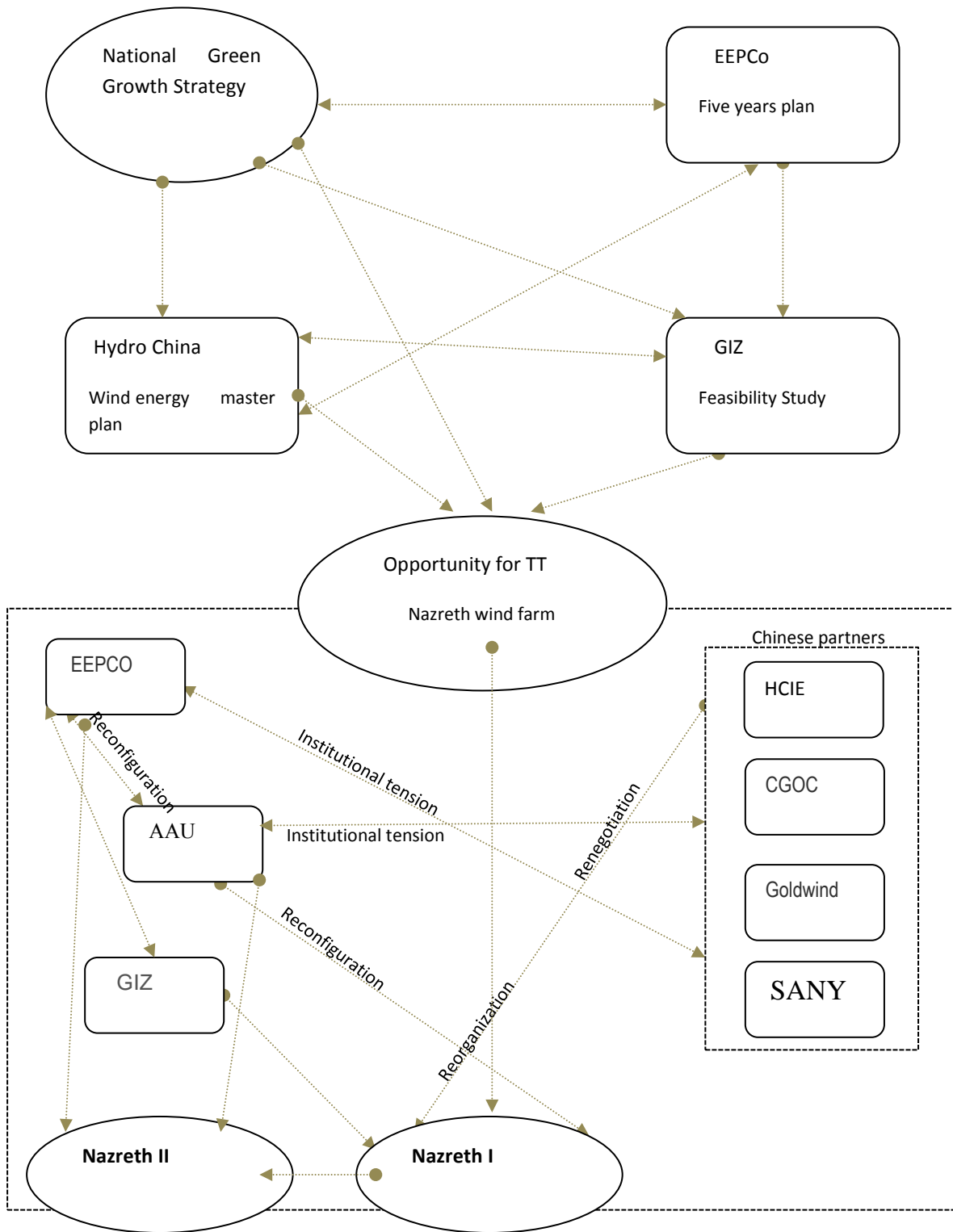
6.2.2 MAPPING TRANSLATION PROCESS

INTRODUCTION

The translation process aimed at building quality relationships among networks results in effective technology transfer. In this regard, Law and Callon's (1992) network analysis model is a relevant framework for analyzing how quality relationships as a function of local networks versus global networks are built on. In this section the translation process is mapped out to investigate the quality of the relationships that exist between the local and the global networks and among the local networks as well as the global networks based on Law and Callon's (1992) model.

The mapping was made by analyzing the degree of mobilization of the local networks versus the level of global networks attachments. The results of the analysis of the degree of mobilization of the local networks and the level of attachments of the global networks were used as the Horizontal and Vertical coordinates respectively. ANT suggested that the relationship quality of networks is affected by the size of networks, alliance experiences, diversity of alliances, degree of alliance friction, alliance future expectations, and so on.

FIGURE 6.5 NAZRETH TRANSLATION PROCESS DIAGRAM



In this section, for the purpose of analyzing the degree of mobilization of local networks and level of attachments of networks, the dimensions of quality relationships were translated to five measurement items in order to categorize them to easily understandable control variables for measurement. These measurement items are: allying size, industry mix, alliance age, shadow of the future and institutional tension. A score that reflects, on average, the degree of mobilization of local networks and level of attachment of global networks, was given as a function of each controlling variable in a range of negative seven to positive seven⁴ scale. The mean score of the measurement items were used to reflect the coordinators of the mapping. Table 6.6 presents the scoring sheet of the controlling variables.

The description of the analysis, the scoring, and mapping process of the case studies is presented in the next sections.

MAPPING TRANSLATION PROCESS: MESSEBO PROJECT

The project started in the horizontal axis of the diagram when Addis Engineering was tasked to conduct the feasibility study with the help of international experts (A) (see Figure 6.6) and climbed up the vertical axis as the EFFORT leadership, Addis, Haltach and the FLSmidth agreed a mutually acceptable terms on the level and type of the technology and the type of cement to be produced (B). To move this set of agreements ENKA was hired to undertake civil and structural works and installation of the structural steel and the entire mechanical erection works of the project (C). Messebo was staffed with local personnel during the erection period of the plant. This enabled the Messebo staff to be familiar with electromechanical system and the structural work of the plant (D). To strengthen the capacity of the Mesebo staff, EFFORT recruited CNMC, which would manage the operation of the plant. CNMC was hired without any competitive process and quality check. The CNMC were unfamiliar with the FLSmidth technologies and this led to institutional tension with the local Messebo staff and crises in the network. The ideological connection between EPRDF, the Ethiopia governing political party, and the China communist party also led to mistrust between the Danish private company, FLSmidth and CNMC. Indeed, in some situations the CNMC found themselves engaged in a race to learn or exploit as much as they could from the FLSmidth's assets. FLSmidth also felt that the private benefits that CNMC could accrue after they have learned from them, outweighs the common benefits of the alliance.

⁴ The absolute number seven was chosen to reflect the higher number of translation processes.

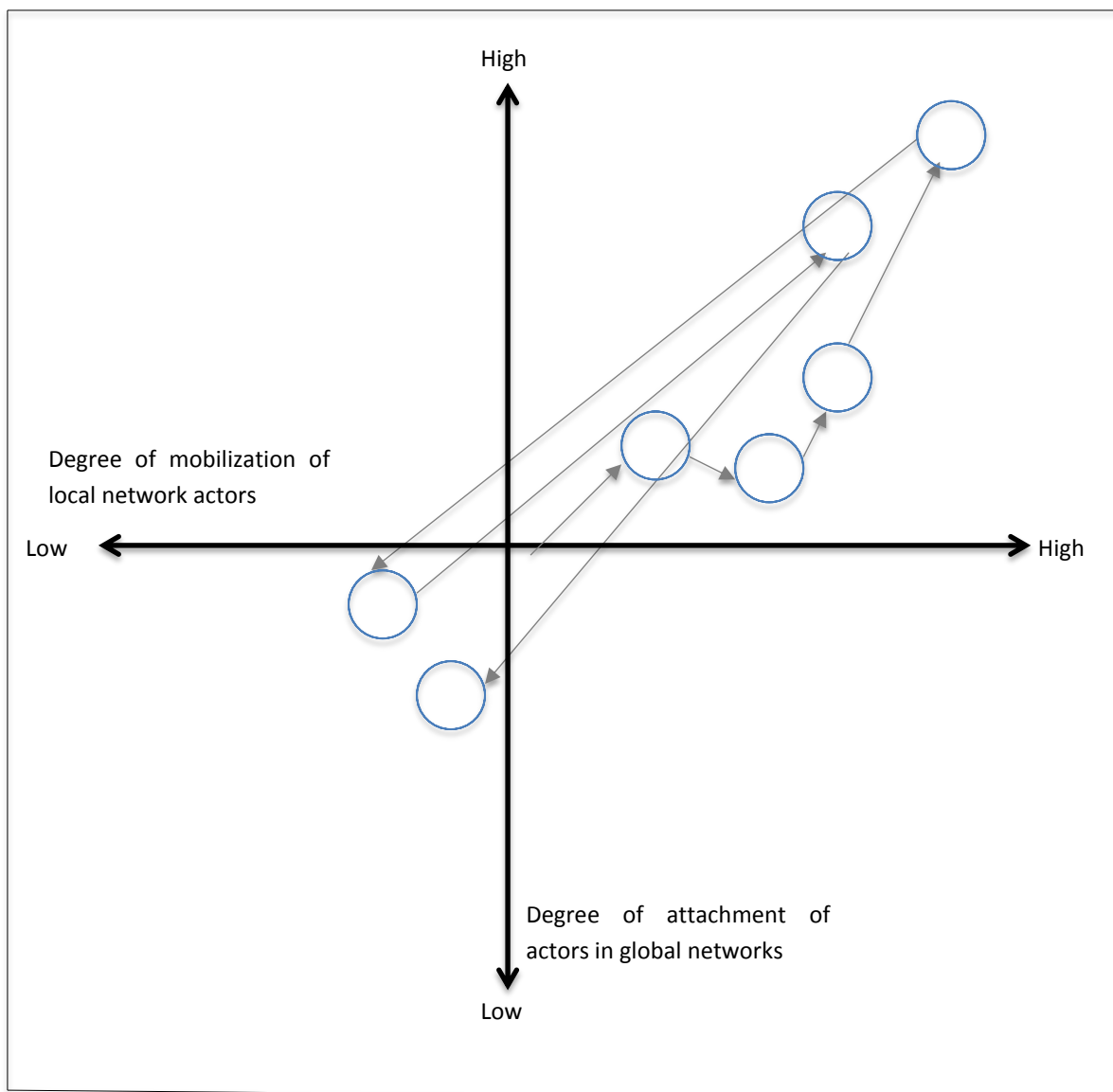
TABLE 6.6 MEASUREMENT ITEMS AND RATING SCALES

Control Variables	Definition	Horizontal Coordinates		Vertical Coordinates	
		Negative 7	Positive 7	Negative 7	Positive 7
Allying Relative Size	Relative number of employees of local networks/ global networks	Small number of employees of local networks relative to global networks	Large number of employees of local networks relative to global networks	Small number of employees of global networks relative to local networks	Large number of employees of global networks relative to local networks
Industry Mix	Number of partners in local networks/ global networks	Small number partners in local networks relative to global networks	Large number partners in local networks relative to global networks	Small number partners in global networks relative to local networks	Large number partners in global networks relative to local networks
Alliance Age	Duration of alliance	Short years of longevity of the local partners in the alliance	Long years of longevity of the local partners in the alliance	Short years of longevity of the global partners in the alliance	Long years of longevity of the global partners in the alliance
Shadow of the Future	The prospect that the alliance will continue	Low prospect the local partners will continue working together with the local network and global partners	High prospect the local partners will continue working together with the local network and global partners	Low prospect the global partners will continue working together with the global network and local partners	High prospect the global partners will continue working together with the global network and local partners
Institutional Tension	Frictions among networks	High organizational tensions and conflicts among the local networks and between local and global networks that lead to negative network alignments	Low organizational tensions and conflicts among the local networks and between local and global networks that lead to negative network alignments	High organizational tensions and conflicts among the global networks and between global and local networks that lead to negative network alignments	Low organizational tensions and conflicts among the global networks and between global and local networks that lead to negative network alignments

Finally, the CNMC management contract was terminated (E). The global network was reconstructed when the decision was taken by EFFORT to rise above its ideological principles and hire a private company, Cementech, through a competitive process (F). However, EFFORT went back to its ideological origin for product marketing and contracted a local network with political party affiliated associations and its subsidiaries for transport and distribution of Messebo product.

This effectively sidelined the global network and other local networks including Messebo management, local transport companies, retailers and wholesalers (G) (the control variables scoring sheet for the Messebo project are given in Appendix C).

FIGURE 6.6 MESSEBO PROJECT NETWORK ANALYSIS (BASED ON LAW AND CALLON 1992)



MAPPING TRANSLATION PROCESS: ASHEGODA PROJECT

The project started in the center of the diagram and climbed up the vertical axis as the EEPCo leadership and the international consortium (GIZ, ADA, and LI) agreed a mutually acceptable objective of developing a wind farm in Ashegoda based on the result of the feasibility study (A) (see Figure 6.7). To move this objective forward a global network was formed (B), which brought together Vergnet Group as EPC contractor, IL as supervisor for the construction work and AFD and BNP as financial lenders. Vergnet reconstructed the global network with African companies namely Somarain Oriental Shipping Co. Ltd and Sarens South Africa (C). Vergnet has long years of experience working with African companies; and the local network worked effectively with the African companies due to existing cultural and historical ties. Vergnet was also effective in building local networks (Rama, Hydo, and SITEC) for civil, erection, geological and drilling works (D). The formation of local-global network was further strengthened in the substation installation works (E) where the local company SIGMA jointly worked with one of the world's leading wind turbine manufacturer, Astom Group. The movement of realignment of actors was seen when EEPCo renegotiated with Vergnet on the technology of the turbines (F) for Ashegoda II and III. EEPCo's decision to install three-blade turbines instead of the original agreed two-blade turbine forced Vergnet to bring Astom Group as supplier of the turbines. Vergnet was looking beyond the Ashegoda project and has started discussing with local and global networks to locally manufacture wind turbine in joint venture (G). If materialized, this could strengthen the degree of attachment of local–global network actors (the control variables scoring sheet for the Ashegoda project is given in the Appendix D).

MAPPING TRANSLATION PROCESS: NAZRETH PROJECT

The project started in the center of the diagram and climbed up the vertical axis as the EEPCo leadership and the Chinese Joint Corporation (HydroChina and CGCOC Group) agreed a mutually acceptable objective of developing a wind farm in Nazreth based on the result of the GIZ feasibility study (A) (see Figure 6.8). To move this objective forward the Chinese global network was strengthened by bringing together Goldwind as the wind turbine and equipment supplier (B) and China Exim Bank as financial lender for the project (C). To strengthen the local network, EEPCo brought AAU as supervisor for the construction work. However, the local network was ineffective partly because of the AAU lack of experience and the Chinese unwillingness to work with local networks. One disadvantage of AAU as technology transfer partners was related to timing. The AAU team did not appreciate the urgency within which the project functions and the team were focused on the production of research publications out of the project rather than the technology transfer itself (D). The

Chinese consortium hired another Chinese company, SANY Group, for moving heavy loads and transporting of the wind turbines. EEPCo employees complained that this type of activity could have been handled by the local or regional network (i.e. other African countries) (E). The discussion of HydroChina with local and global networks to locally manufacture wind turbines in joint venture (F) could reconstruct the attachment of local-global networks, if it materialised (the control variables scoring sheet for Nazreth project is given in the Appendix E).

FIGURE 6.7 ASHEGODA PROJECT NETWORK ANALYSIS (BASED ON LAW AND CALLON 1992)

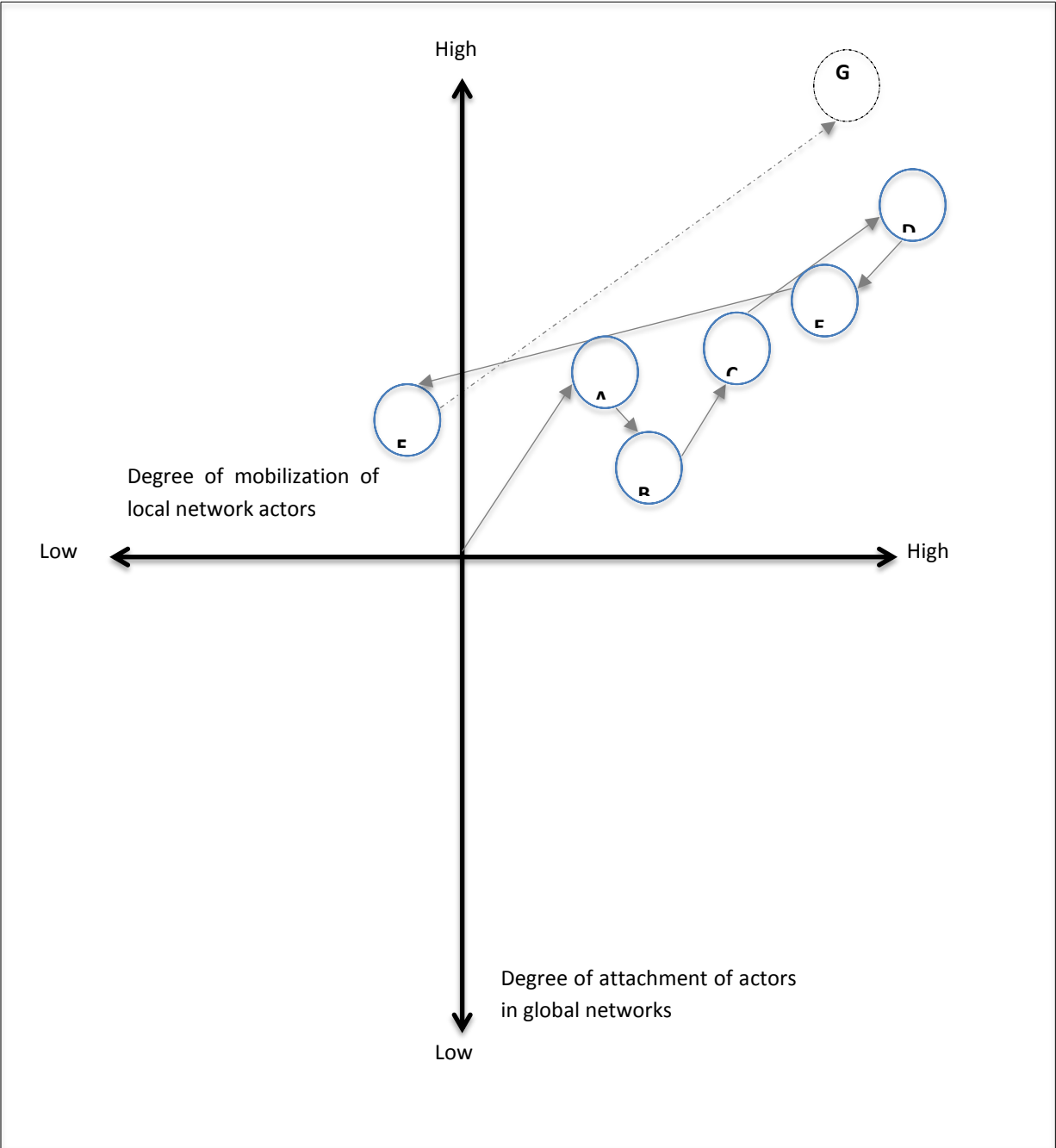
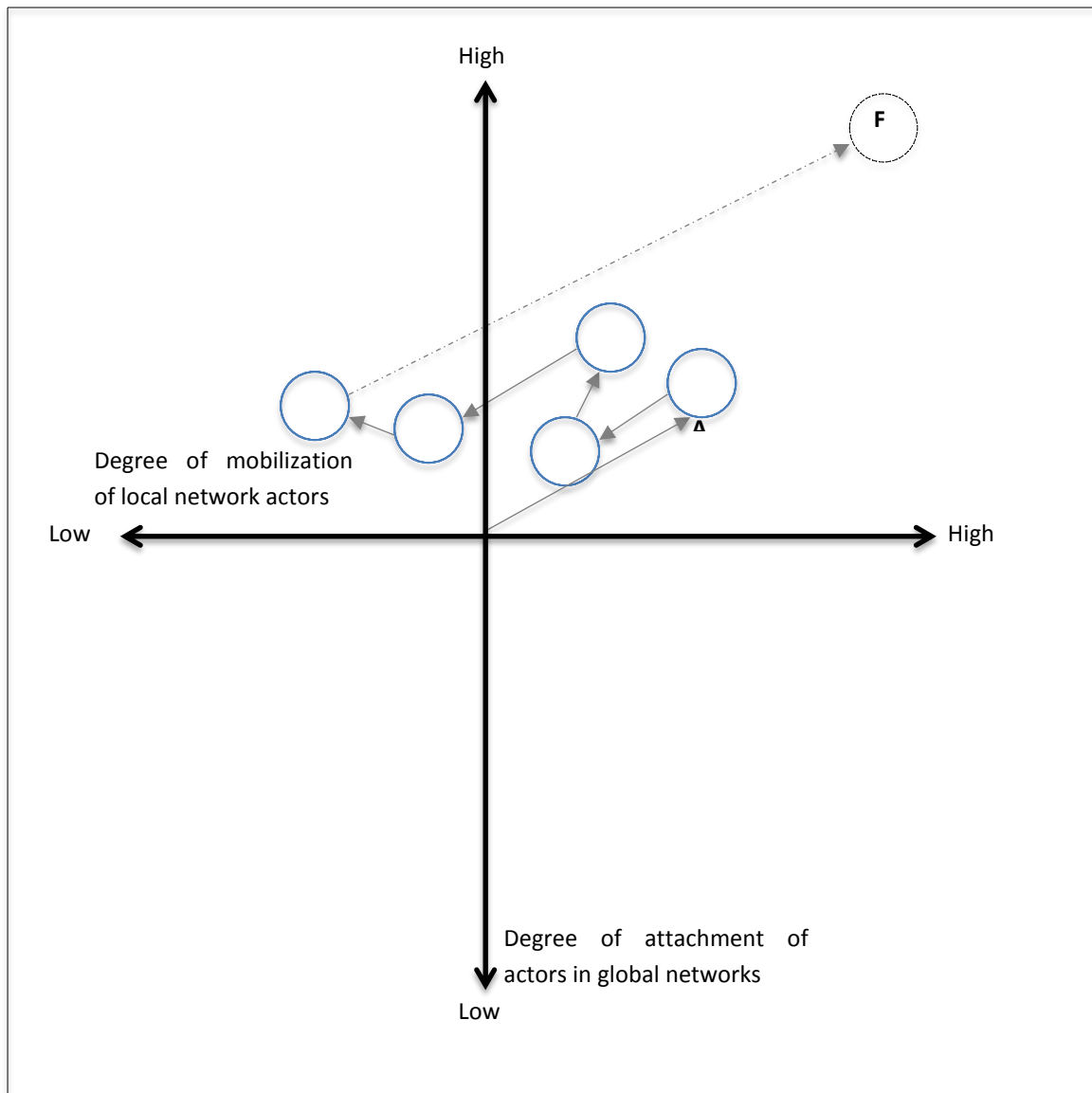


FIGURE 6.8 NAZRETH PROJECT NETWORK ANALYSIS (BASED ON LAW AND CALLON 1992)



6.3 MEASURING TECHNOLOGY TRANSFER USING TAC

6.3.1 ABSORPTIVE CAPACITY INDICATORS: SURVEY AND TESTING RESULTS

Analysis of the case studies using ANT as a framework highlights the importance of access to information for technology transfer. However, the Ethiopia network’s ability to value, assimilate, and utilize external information is also an important aspect of the network quality for effective technology transfer.

As stated in the methodology section, a survey was conducted to identify the aspects of absorptive capacity that matter most to the selected case studies. Of the absorptive capacity constraints listed, the largest number of respondents (40%) attributed a high degree of importance to lack of qualified personnel to utilize external knowledge. The next highest

constraint (29% respondents) was the perception of managers to invest the necessary resources for enhancing the internalization of external knowledge, followed by poor infrastructure such as IT (16% respondents) and poor political environment. The last 15% indicated methods of technological learning or technology transfer channels as critical factors for enhancing absorptive capacity. The two Vergnet personnel interviewed put infrastructure first, qualification second and managers' altitude third. Whereas the three EFFORT interviewees had dissimilar views on highest constraint: two of them attributed high degree of importance to management perception followed by lack of a rich pool of technical talent. The other EFFORT interviewee listed lack of qualified personnel first and management perception second. One of the three interviewees of EFFORT listed poor advancement of IT infrastructure as the third highest constraint; however, the other two EFFORT personnel didn't respond to questions related to infrastructure. For the three HydroChina interviewees the first, the second, and the third constraint were only one factor and that was lack of qualified personnel.

The two major constraints identified by the survey and interview: qualified personnel and management perception were assessed in terms of workers experience, education background, quality of training, and managers' altitude. The personnel qualification is related to knowledge and capability whereas the second factor, management perception, reflects assumptions and beliefs. These categories echo the findings of Nieto and Quevedo (2005), which stated that the ability of the firm to exploit external knowledge (absorptive capacity) is greatly influenced by the firm's previously held basic assumptions, beliefs, and knowledge.

In summary, the findings of the survey are inline with the critical factors of absorptive capacity that were identified by researchers such as Lin et al. (2002), Minbaeva et al. (2003), Nieto and Quevedo (2005) and Sazali et al. (2009). These factors connect cumulative experience within the firm and the extent to which this knowledge is related to external information (Cohen and Levinthal 1994, Allen 1977). Further, the knowledge of individuals influences their ability to utilize external information (Anderson 1991; Newell and Simon 1972). The implication is that differences in the human capital allocated and embodied in individuals are sources of variability that influence learning in the alliance.

Government science and technology policy designed to foster technology-based economic development for the success of technology transfer is not treated in this section as it is already covered in Chapter 5. A strong research and development base and the availability of capital are also binding constraints for enhancing the absorptive capacity of the local

network. However, both constraints are very much related to the overall development level of the country and its science and technology policies. Therefore, these factors are also not covered in this chapter of the dissertation.

The identified indicators to assess the absorptive capacity of local firms, namely prior expertise and experience, educational level, trainings, manager’s perception and learning mechanisms are discussed in the following sections. Teamwork, staff morale, and internal communication, which also reflect assumptions and beliefs, are discussed under the management perception section. Availability and usefulness of information technology (IT) is covered under the “training and learning by doing” section. The assessment of absorptive capacity for the three case studies is summarized at the end of the section.

6.3.2 EDUCATION LEVELS AND PRIOR EXPERIENCES

Qualification is one of the first predictors of an individuals’ ability to utilize new knowledge. Through the qualifications portion of the survey, this study found that the majority of staff (34%) at Messebo had college diplomas (2-3 yrs of study), whereas at EEPCo (65%) they had Bachelor of Science degrees in engineering (5 yrs of study). Recent trends indicate that Mesebo recruits candidates with bachelor's degrees more often than candidates with college diploma. EEPCo did not have employees with PhD degrees and no one had specialized training in wind energy. In Messebo none of the employees had specialized training in cement technology and chemistry and there was a single employee with automation engineering, which is the central part of the company technology make up.

Limitations in man power in specialized areas like wind energy, cement technology and automation energy is due to the developing educational base of the country. None of the Ethiopian colleges and universities provide professional training in these specialized fields.

TABLE 6.7 NUMBER OF EMPLOYEES AND THEIR QUALIFICATIONS

Education level	Messebo5	EEPCo
PhD Degree	1	-
Master’s degree	12	5
Bachelor degree	111	20
Diploma	207	11
High school certificate	87	-
Below high school	88	-
No Qualifications	94	-
Total number of employees	600	36

⁵ Messebo staff includes guards and cleaners but this analysis does not include them. The total number of Messebo staff including this group was 800.

Literature in the field of organizational learning reports that organizations that possess relevant prior knowledge are likely to have a better understanding of new technology that can generate new ideas and develop new products (Nieto and Quevedo 2005). 75% of EEPCo project employees have more than five years of work experience in EEPCo but none of them have work experience in wind energy farms. EEPCo is the only utility company in the country that engaged in the business of construction, generation, transmission, distribution, and selling of electrical energy. This could be the reason that none of the EEPCo project staff worked in any other similar company. In Messebo none of the employees had worked in a cement company, even though 35% of them had work experience in other processing industries.

6.3.3 TRAINING AND LEARNING BY DOING

This section examines the type of training that can serve to enhance overall absorptive capacity delivered by the global network to the local network, mainly to Messebo and EEPCo.

In the Messebo case there were three types of training: 1) Visits (Observation Assignment) 2) Theoretical classroom lectures and, 3) Apprenticeship training.

The employer (Messebo) and the supplier (F.L. Smidth) covered costs for the first training type. The supplier covered the training cost for the second, whereas the project management contractors, China National Materials and Cementech International, covered the training cost for the third one. Visiting training (1st training) covered cement plant visiting with technological briefings in Denmark, Italy and Pakistan and the trainee team included a 25 personnel senior Messebo technical team. They learnt by observation of the operation and management of different cement plants for two months. This training included both operative and plant management.

The theoretical classroom lectures (2nd training) were delivered by F.L. Smidth expatriates in the premises of the Messebo plant. The training covered the basics of cement technology and chemistry. F.L. Smidth also provided on the job practical training for about two years. This training included the method of operating the machines and both preventive and corrective maintenances. The objective of the last training type (3rd training) was to understand complete proficiency in machine operation and plant management. The trainees (Messebo staff) were supposed to work as apprentices under the direct supervision of China National Materials (CNM) experts for three years. However, except the automation engineering section, in all other parts of the plant operations and maintenance the Messebo staff were better prepared than the CNM experts.

Language problems, coupled with the CNM experts' unfamiliarity with FLSmidth technologies, made the training a total failure. As a result, Cementech took over the plant management contract from CNM. The contract with Cementech included providing actual work experience on the job, as well as imparting theoretical knowledge through class room lectures. As part of the Cementech management-training programme the Messebo management was put as an "understudy" and were made assistants to the Pakistani managers.

The Messebo management learnt from Cementech by experience, observation, and imitation. The production department management training resulted in practical changes in the operation system of the kiln (the major part of a cement technology). Whereas in other areas especially in quality control and marketing there was no significant outcome. In the operative part of the training, the Pakistani automation experts trained the Messebo staff in some basics of preventive maintenances and minor corrective maintenance of the automated machines. However, the Messebo experts were yet not able to manage the corrective maintenance of automated machines because of the lack of local automations engineers.

Both the Cementech and CNM training was not well organized, for example, training materials were not well prepared; and proper documentation of their operation and maintenance activities, and documents related to production programs and re-engineering activities were not systematically organized. However, the Messebo documentation and reference room was full of F.L. Smidth training materials and F.L. Smidth O&M documents (operation and maintenance materials).

The training formats and contents of the two wind energy projects were similar; however, allocation of training hours was not the same. In both cases there were two types of training 1) theoretical and 2) apprenticeship training. In the case of Ashegoda almost all training took place at the project site, except a two month visit to the Vergnet workshop in France, which included 25 EEPCo engineers. The Nazreth project included a two month long theoretical training and wind farm visit in China for 30 EEPCo engineers. In both cases the theoretical part of the training covered topics such as wind turbine generating systems (WTGS), tower and transformer factory, WTG manufactory practice, tower manufactory practice, WTG transportation and installation theories, wind park operation practice, and wind park maintenance practice.

The apprenticeship-training component (2nd training) for both projects was simply the five years of operation and maintenance, where in both cases the EEPCo employees worked as apprentices under the direct supervision of Vergnet experts (in the case of Ashegoda) and China experts (in the case of Nazreth project). This part of the training in both cases commenced immediately after erection and commissioning of the project. In the Nazreth

project the training was conducted with a simultaneous translation; and in some occasions EEPCo employees found it difficult to understand the translation since translators were unable to use technical terms.

Internet access, purpose of use and skills can indicate the level of absorption of technologies within an entity. Information technology enables employees to both use existing knowledge and create new knowledge, both of which are crucial for adoption of innovation (Craig et al 1997). In this regard, percentage of internet access and purpose of internet use were part of the assessment of learning by doing. The research found that 45% of Messebo and 85% of EEPCo employees had access to the internet from their desks. The internet access rate seen in both case studies is very high compared to the national internet penetration rate. The internet penetration rate in Ethiopia is just 0.4, which is the second lowest internet penetration rate in sub-Saharan Africa, only Sierra Leone’s is lower (International Telecommunication Union 2010).

Despite the high internet penetration rate in the case studies, the workers in both cases, in particular the Messebo employees, did not use the internet for business purposes, but instead for private uses such as accessing social media (for example Facebook). Messebo could not complement its traditional channels of marketing communication with internet, not least to reach certain kinds of consumers such as multilateral construction companies, even though so many of their employees eyes were looking at computer screens daily.

At the time of conducting this research Messebo did not have a website and or a plan to create one in the near future. The wind farm projects are part of power generation, and EEPCo employees were not expected to work on product marketing. However, they could have created project websites for awareness purposes. The technical staff in both cases could have benefited from the technical information available on the internet for operation and maintenance. In general, despite the high internet access available in all the three case studies, the internet was not used wisely for business purposes.

TABLE 6.8 PURPOSE OF INTERNET USE IN MESSEBO AND EEPKO PROJECT STAFF

Main purpose of internet access	Messebo % of use-time	EEPCo % of use-time
Research and business email	5%	34%
Marketing	0.1%	-
Social media and private email	94.9%	66%

The internet could have helped the local workers both in Messebo and EPPCo to collaborate with the machine suppliers as well as other professionals working in a similar industry set up willing to share information and references. The researcher, with the help of cement and wind technology experts in Germany, confirmed the availability of material in both fields that simulate typical scenarios that professionals encounter in real-world settings, such as inspection, preventive maintenance, corrective maintenance, product (Cement) design, and operation optimization. These materials integrate intelligent tutoring systems, concept mapping, immediate feedback, and opportunities for reflection, including the chance to replay recorded events and adopt alternative decision paths.

As Herrington et al. (2002) reported these Web-based learning environments could give industry trainees access to many of the same resources that professionals use in their research and real-life experiments. Both Messebo and EEPCo local workers do not utilize this opportunity, not because they don't have the internet access, but as reported in Table 6.7 because of poor utilization of the internet for professional development.

6.3.4 MANAGERS PERCEPTION AND CAPABILITY

Absorptive capacity of firms also depends on the extent that the firms' internal environment that emphasizes knowledge assimilation and sharing, creation of continuous learning capability, and managers who are challenged to emphasize organizational learning capability (Cohen and Levinthal 1990). The response of managers at Messebo and EEPCo to these challenges depended mainly on the country's political environment, availability of capital, and their own capability and perception of constraints of absorptive capacity.

This section focuses on managers' capability and perception. For this study the Messebo management team includes all management committee members, which included the six department heads (Production, Quality Control, Maintenance, Human Resource, Finance and Marketing) and the General Manager. Whereas in the EEPCo case, it includes the two REs (Resident Engineers at Ashegoda and Nazreth), the two heads of the projects in the project offices at the EEPCo headquarters and the generation construction executive officer. The heads of the three Messebo technical departments have a master's degree in either engineering or science, whereas none of the other departments (HR, Finance and Marketing) have degrees higher than bachelor degree. All of the Messebo managers have prior experience in other companies. However, the heads of the technical departments had never worked in managerial positions prior to joining Messebo, and never had any managerial training. However, the other three managers had worked in other companies in a similar position. Five of the EEPCo managers had master degrees in engineering, and had some

sort of management training, but had never worked in other organizations in managerial positions.

Informal discussions were conducted with some of the managers of the two case studies to understand and identify factors and determinants for managers' perceptions for constraints of technology absorption. The discussion was focused mainly on identifying the obstacles to solve problems related to absorptive capacity from a managerial point of view. Based on results of the informal discussions and personal observations, three factors were identified:

1. Board or senior management engagement
2. Work autonomy
3. Teamwork, staff morale, and internal communication

Structured interviews were conducted to get a sense of the managers' perceptions on solving the three constraints of technology absorption.

1. BOARD OR SENIOR MANAGEMENT ENGAGEMENT

Messebo

The Messebo managers feel that EFFORT, the owner of Messebo Company, does not follow up the company and is slow in responding to their requests.

EEPCO

The managers at EEPCo, on the other hand, feel that senior management does not have a mechanism to encourage those employees who come up with innovative ideas. And the "doers" are prevented from making decisions on training without going through elaborated justification and approval procedures. Senior managers don't encourage project managers to bend rules and the rigid procedures in order to enhance absorptive capacity.

2. WORK AUTONOMY

Messebo

EFFORT makes direct intervention in managers work and sometimes indirectly through junior employees who have direct contact with EFFORT board members because of their political party membership. Some management members cited EFFORT intervention in staff hiring and promotion and subcontracting activities in particular in product marketing.

EFFORT sometimes makes unpredictable decisions on management committee members; as a result there is uncertainty in managers' position.

EEPCo

Senior management doesn't provide the freedom to project managers to use their own judgment on hiring and promoting of project staff.

3. TEAMWORK, STAFF MORAL, AND INTERNAL COMMUNICATION

Messebo

- Employees don't work in a team across departmental or functional boundaries, in particular there are considerable gaps in creating a team spirit between technical departments and other departments.
- Management is not aware of new ideas and suggestions from employees.
- Employees simply follow standard operating procedures or practices to do their tasks.

EEPCo

There is not a strong desire among employees in the organization for working in a team by crossing departmental or functional boundaries.

Teamwork, staff morale, and internal communication ratings were also assessed through a survey of 35 selected Messebo employees (mid-level managerial positions including shift engineers, senior chemists, supervisors) and the 34 EEPCo staff (mid-level managerial positions including senior engineers and supervisors). Table 6.9 reports the findings.

TABLE 6.9 STAFF SELF-RATING OF TEAMWORK, STAFF MORALE, AND INTERNAL COMMUNICATION

Factors	Ratings	Messebo (No. of staff)	EEPCo (No. of staff)
Teamwork	Very good	14	6
	Good	17	13
	Fair	4	15
Staff morale	Very good	7	3
	Good	18	23
	Fair	10	8
Internal communication	Very good	4	11
	Good	18	22
	Fair	13	1

6.3.5 SUMMARY OF THE ASSESSMENT OF ABSORPTIVE CAPACITY

All the three case studies use sophisticated technologies that they acquire almost entirely from foreign vendors; and the technology transfer entails the use of others' management capital and know-how, equipment and competencies.

The critical component of this technology transfer is the consulting services provided by the technology producers from Denmark, China and France, who spent years in Ethiopia training the local workers on the new machinery and equipment. The hiring of foreign companies for the operation and maintenance of machines and equipment complemented this technology learning. Messebo had a plant management contract with Cementech (Pakistan) and CNMC (China), whereas the two wind farm projects made the operation and maintenance agreement part of the technology acquisition project contract.

None of the case studies had exchanges of technical information and staff exchange programs, and they had limited formal R&D. These kinds of links could have been critical to the firm's ability to sustain technological learning. Moreover, none of the case studies had any substantive engagement with international or local research institutions. The only major research activity was observed in the Messebo case study. In 2005 a local Chemist at Messebo plant, who was inspired by the concept of cleaner production, and obtained some advice from a F.L. Smidth expatriate, initiated research and development for the production of environmental friendly cement together with local process engineers. The research activity got the full support of the Messebo senior management and ended up with the production of Portland Limestone Cement (PLC).

The qualifications portion of the survey found that in all the three case studies the local networks, mainly Messebo and EEPCo employees, didn't have specialized training and prior experiences in the respective areas of operations such as in cement technologies and wind energy; but employees in both cases had the basic educational qualification that would enabled them to utilize new knowledge.

In all the three case studies, training by the international suppliers and contractors had received proper attention, and was part of the project contract agreements. However, in all cases, the local owners of the projects i.e. Messebo and EEPCo, didn't institutionalize the training programs they received from the global networks, in particular the commissioning time intensive classroom training sessions. At the time of conducting this research both firms did not have separate training centers.

Despite the limited licensing in area of automation programs in Messebo, there was no substantive interest from the managers to get access to technology improvements through licensing in all the three cases. This could be because of the limited capacity the local networks have to convert patents to commercial products. To operationalize automated technologies including the QCX system (Quality Control by X-Ray), Messebo obtained program licenses from different companies in Switzerland, United Kingdom, and Italy through FLSmidth. The EPC contractors and the machine suppliers didn't disclose any of their confidentiality information, such as wind turbine design documents to the local networks. EEPCo, the employer for the two wind projects, was interested only in getting certification of product quality from its consultants.

TABLE 6.10 SUMMARY OF TECHNOLOGICAL LEARNING METHODS

Method of Learning	Merssebo	Nazreth	Ashegoda
Technology acquisition	Main technology from FLSmidth (Denmark).	Main technology from Goldwind (China).	Main technology from Vergnet (France).
Hiring technical experts	Technical experts from India, Denmark, Turkey, China and Pakistan.	Technical experts from China	Technical experts from France and Germany.
Technical training, meetings and consultation	Training in Denmark, China, Pakistan, and onsite training by Danish, Chinese, and Pakistani expatriates.	Training in China and onsite by Chinese expatriates.	Training in France and onsite by European expatriates.
Technology data, information and documentations	The supplier in addition to operation and maintenance manuals made specific technology data available.	Engineering documents in relation to operation and maintenance as well as foundation design and underlying data were made available. However, the local networks were not allowed to see Wind Turbine design documents.	Engineering documents in relation to operation and maintenance as well as foundation design and underlying data were made available. However, the local networks were not allowed to see Wind Turbine design documents.
Independent R&D and links with international and research institutions	In the first years of the plant operation there were limited formal R&D. However, since then there was not any form of R&D.	Nil	The Ashegoda site served as a study site for the local university (Mekelle University), however, they did not have a formal research agreement.
Licensing	Programs for most of the automation parts including QCX parts from F.L. Smidth.	Nil	Nil
Technical exchanges	Nil	Nil	Nil

6.4 CONCLUSION

The three modalities of cooperation (SSC, NSC and NSSC) showed distinct characteristics and resulted in dissimilar climate technology transfer levels of effectiveness. The selection of the case studies based on the existence of different modes of cooperation (Nazreth for SSC, Ashegoda for NSC and Messebo for NSSC) enabled the analysis to compare the three modes of cooperation when necessary and gauge the performance and effectiveness for enhancing technology transfer. The effectiveness of technology transfer in the three cases was highly dependent on the networks that could be established with the local and global networks (global North and South) and the learning efforts of the local networks. The analysis of the case studies using ANT as a framework highlights the importance of access to information for technology transfer. However, the Ethiopian firms ability to value, assimilate, and utilize external information was also an important aspect of the network quality for effective technology transfer.

In NSSCTT and NSCTT, a better training approach and effective learning service was observed, even though in all the three case studies training by the international suppliers and contractors had received proper attention, and was part of the project contract agreements. The Danish company, FLSmidth, training materials for Messebo employees, and Vengrat, the French company training for EEPCo and Mesfin Engineering employees, were better organized and well received by the local employees compared to the Chinese and Pakistani training materials and approaches. Despite difference in provision of training by the global networks to the local ones, the skill base of the local firms was similar in the three case studies (SSCTT, NSCTT and NSSCTT), which enabled comparison of the three technology cooperation modalities easier.

This also made possible a comparative analysis focusing on the capacity of accessing external knowledge, since the ability of the local networks was similar across the three case studies. The qualifications portion of the survey found that in all the three case studies the local networks, mainly Messebo and EEPCo employees, didn't have specialized training and prior experience in the respective areas of operations, such as cement technologies and wind energy, but employees in both cases had the basic educational qualification that would enable them to utilize new knowledge. The internet access rate seen in the three case studies was very high compared to the national internet penetration rate, however, in all cases the internet was not used wisely for business purposes.

Key findings from the three case analyses show that, as the result of the transfer of knowledge from the global to the local networks, technological capacities have changed in all the three modalities of technological cooperation, but at different levels.

The level of transferred technologies to the local networks could be summarized according to the classification of Lall (2000) and Hansen (2008). In NSSCTT, Messebo, technological capacities was mainly intermediate level (know - what), particularly because of the local employees success in product optimization, but it was also partly limited to basic level (know - how) because there was no substantial reengineering activity or formal research and development related activities.

In the NSC, Ashegoda case, some characteristics, or potential of the intermediate level technological capability, were observed but the technological capacities remained largely at a basic level. This was manifested in the local networks that worked together with the Northern companies had already developed the capacity of reengineering activities, but the local networks of EEPCo capacity did not go beyond undertaking ordinary operation and maintenance of the wind farms. Whereas in SSC, Nazreth, technological capability was not more than the basic level because in this case local staff were limited to undertaking operation and maintenance of the wind farms with the oversight of the expatriates. This was mainly due to the limited opportunities that the local networks in the SSC had to connect with the global network and with each other. The detail findings that led to this conclusion are presented as follows: in NSSC, Messebo, the technological machinery and equipment were operated and maintained fully by local networks.

The introduction of environmentally friendly products (Portland Limestone Cement (PLC)) by the Messebo local workers, based on the knowledge gained from F.L. Smidth expatriates (Denmark), demonstrated that the capacity of the local workers was improved as the result of the technology transfer, enabling them to undertake incremental minor adjustments, modifications improvements, and optimization. The ingredients of PLC require lower heat to burn thereby saving on the cost of fuel and minimized the production of environmentally unfriendly by-products whilst producing a useful product in finishing and plastering. PLC was a new-to-the-company product but not new-to-the-market product. The Messebo local employees also undertook replacement and repair of mechanical and electrical parts of the technology. To some extent, they have developed the capacity of maintaining and replacing minor automation components.

In the NSC, local networks that worked together with the Northern companies in the Ashegoda wind farm project, mainly Mesfin Engineering P.L.C., already obtained subcontracts from the new other wind farm, Ayisha wind farm project, to fabricate minor components. Rama General construction P.L.C, the other local company that participated in

the project, obtained an offer to manage the civil construction of Ayisha wind farm project. On the other hand, in the Nazreth wind farm projects since broad local networks were not involved except EEPCo and AAU, the technological learning was limited. The EEPCo employees couldn't go beyond the daily operation and maintenance work of the wind farm, whereas the AAU didn't take participate in any wind farm projects after its failed participation in the Nazreth project.

This research revealed that in south-south cooperation there are limited linkages between the global companies and local enterprises, and this negatively affected the effectiveness of climate technology transfer.

The network belonged to a common pool or domain of information and circulated the same information. Using the terminology of ANT, redundant ties characterized the SSCTT, whereas NSCTT and NSSCTT involved broad-networks with a number of disconnected actors, and these were connected as a result of the goals of the specific projects in question. The disconnection between contacts implied that actors are connected to non-overlapping sources of technological information. In the terminology of ANT, both cases were non-redundant networks. ANT suggested that networks characterized by greater non-redundancy in ties provide access to a greater range of new, unique and different technological information than networks that lack non-redundant ties (Burt 1992). Messebo (NSSCTT) and Ashegoda (NSCTT) networks, which were non-redundant in ties, were more powerful for technology transfer than the Nazreth (SSCTT) networks, which didn't involve broad networks, and the networks relationships were characterized by low frequency of interactions, which resulted in less effective transfer of technology. In the Nazreth (SSCTT) networks Chinese firms dominated the network and local networks did not get the chance to connect with the global network, or with each other.

The Ethiopian government, owner of the project, was well aware of the redundant ties in SSC and the dominancy of the Chinese network in project consortium. The government project contract put limitations on the number of Chinese experts employed, demanded the contractor to hire local sub contractors as much as possible, make available necessary documents in English, and provide training to local experts. However, the contractual agreement was not respected when it came to limiting the number of Chinese experts.

The research also found some limitations in NSCTT, including delays in project completion, cost ineffectiveness, relatively limited understanding of local situations, and promoting technologies that didn't readily adapt to the context of the local situations.

The Ashegoda wind farm (NSCTT) was supposed to be completed within 10 months, but it took 16 months. In comparison, the Nazreth wind farm (SSCTT) was completed in 11 months, which was shorter than its contractual completion date, 12 months. To meet construction time for Phase II and III of Ashegoda, the contract design of the Ashegoda wind farm project was altered to include turbines generating more power in the second and third phases of the project; the number of turbines went down from 90 (original plan) to 45 turbines to generate the same 90MW.

As a result, the wind farm was relocated from its original planned site, the Western slopes of the ridges, to the eastern area, which is more mountainous with turbulent winds. This change in the design of the project complicated the process, and the new mountainous location of the turbines was ill-suited to the Vergnet turbines. As a result, instead of its own windmills, the French company, Vergnet, needed to bring another France company, Astom Group, as the supplier of the turbines, 54 Alstom ECO74 1.67MW three-blade turbines. The patchy roads from the port (Djibouti) to project site (Ashegoda), with its destroyed bridges, also made for longer routing, preventing project components from reaching the site on time. The contractor, Vergnet, didn't plan transportation of the machinery and equipment based on the actual road conditions. The change in design, coupled with the re-planning of the transport, resulted in project cost escalation.

At the time of this research, the final actual cost of the project was not completed but one of the Vergnet Group site engineers at Ashegoda explained "we have lost a lot of money and we don't expect to make any money" (Interview with Alphonse Dumortier on September 16, 2011).

Though this research found that the NSSCTT was relatively the more effective modality of cooperation for enhancing climate technology transfer because it combined the comparative advantages of both SSCTT and NSCTT, the research revealed some limitations. Identifying the common interests of the three actors (The North, South and the host country) places additional demands on the management capacity of all the actors, in particular on the host country to ensure each actor plays its designated role.

In the Messebo case (NSSCTT), there were occasions when the Chinese company, CNMC, found itself engaged in a race to learn or exploit as much as they could from the global north (Denmark) firms', F.L. Smidth's, assets and technologies. In the NSSCTT technology transfer process, both F.L. Smidth and CNMC were supposed to play the role of transferors where-as the Ethiopian firm, Messebo, was a transferee, but CNMC was engaged not as transferor but as a transferee. F.L. Smidth also felt that the private benefits

that CNMC could accrue after they had learned from them, outweighed the common benefits of the alliance. In the end, the CNMC management contract was terminated.

The research revealed the negative effects of state capitalism, and SSC political solidarity, in the effectiveness of technology transfer at the firm level. In South-South cooperation, there is a higher level of commitment and self-confidence from higher-level political officials, who also sit on management boards of state owned companies. In contrast, the operational company management would like to rise above the SSC political discourses and focus on results on the ground. This created frustration and friction between the more ideological company board members and the more professional management of the company senior local managers; and also resulted in high levels of mistrust between other actors. This in return undermined effectiveness of technology transfer.

Divergence between commercial decision-making (senior local managers) and the demands of the wider political rationale (company managing board) became more evident at the time of project consortium establishment, when project contracts were offered to Chinese state owned companies based on already existed ideological relationships between the Communist Party of China (CPC) and the Ethiopia governing party, Ethiopian People's Revolutionary Democratic Front (EPRDF), without a competitive process and quality check. In actual project operation, other actors which were outside of the ideological network, found it hard to settle technical project implementation differences, and find common ground with the Southern contractors, such as the Chinese and Pakistanis. In particular, the Chinese used to take issues and differences they had with other actors directly to Ethiopian higher political figures without consulting the local company/project management.

Key findings from the research analysis showed the complementarity nature of NSCTT and SSCTT, and ratified NSSCTT as one important way of strengthening the effectiveness of this complementarity and fostering technology transfer by leveraging the best features of NSCTT and SSCTT.

The analysis revealed that despite some of its limitations, NSSCTT could compensate for certain constraints and overcome NSCTT and SSCTT imitations that may limit their effectiveness. The mutual learning that was observed between NSCTT and SSCTT in order to complement each other was one of the manifestations of NSSCTT to be the future most promising modality of technology cooperation for more effective climate technology transfer.

For example, NSCTT has learnt from SSCTT on how to make their engagement long-term and work with government owned companies. On the other hand, the SSCT has learnt technological know-how and developed better technological learning from the NSCTT. For

example, the Chinese companies looked beyond the Nazreth wind farm project and were in the process of establishing an assembly plant in the short-term, and a manufacturing plant in the long-term, with the newly established government owned electromechanical company, Mtech Ethiopia. The French company, Vergnet Group, which was working in the Ashegoda wind farm, drew a lesson from the Chinese, and started negotiating with Mtech Ethiopia and the Chinese companies to join the joint-venture to locally assemble and manufacture wind turbines. If materialized, this joint venture will serve as a partnership platform for the major networks in the NSCTT of the Ashegoda, and SSCTT of the Nazreth, wind farms to strengthen the transfer of climate technology from the global networks to local ones (Ethiopian firms) in a NSSCTT modality of partnership. On the other hand, in the Messebo case, the Pakistani company, Cementech International, successfully learnt from the Danish company, F.L. Smidth, about the provision of quality technological learning services. Cementech used F.L. Smidth training materials and instructions methods to reorient its own approach and provide a better technological learning service to its Ethiopia partners.

CHAPTER 7 CONCLUSIONS

7.1 OVERALL CONCLUSIONS

7.1.1 MAIN CONCLUSION

This final chapter provides an overview of the most important conclusions of the thesis. It seeks to answer the central research question and reflect on the findings of the analysis. Furthermore, this chapter elaborates on the empirical and policy implications of the study, its limitations, contributions; and reflects on the methodology and suggests areas for future research.

The thesis examines relationships between multi-leveled decision making structures for climate technology transfer through an exploratory assessment of both top-down macro policy, and bottom-up micro implementation. The thesis employs multiple data collection methods (a combination of survey, observation, and case study) and iterative explanation building. In addition, the thesis uses concurrent data analysis techniques to address the research question: *what is the relationship between firm practices, national policies, and international discourses for climate technology transfer? Is there a disjunction? If so, then why?*

The thesis seeks linkages between the top-down and bottom-up processes, and aims to reflect the dynamic nature of climate technology transfer. This linkage explains how climate technology transfer decisions at different levels are being shaped and reshaped by changes that occur on other levels, either above through top-down processes, or below through bottom-up processes. The research examines how international climate technology transfer policy, negotiated under the UNFCCC, filters down to national policies and ultimately to the micro entities such as firms and companies. Reciprocally, the thesis examines how climate technology transfer practices at the firm level is reflected in national approaches and is molded by international climate policies.

The thesis concludes that, in relation to the research question, the three levels (international, national and local) are more loosely coupled than is needed for effective climate technology transfer. The research revealed that there is relatively good accord between international climate technology transfer discourses under the UNFCCC and the national technology transfer policy. There is also good compliance between national policy and firm level climate technology transfer practices. However, there is a clear disjunction between the international and the local level because the international climate regime focuses on NSCTT and pays less attention to SSCTT; while the local level focuses on the complementary nature of NSCTT and SSCTT.

The loose interconnections between the three levels in the intense interplay of top-down and bottom-up processes have resulted in a mixture of coherence and incoherence in the relationships between the three levels. Results from combining top-down macro-policy analysis (mainly in Chapters 4 and 5) with bottom-up micro-implementation analysis (mainly in Chapter 6) revealed the existence of the different levels of coherence between the multi-leveled decision structures for climate technology transfer. The following findings of the research explain these arguments further:

(1) Chapter 4 discusses the historical contingency implicit in the principle of 'differentiated responsibilities' of international climate policy under the UNFCCC. This has led to a simplistic view of technology transfer as "North-South." The transfer of climate technology from the global north countries to the south has dominated much of the technology transfer discussion in the UNFCCC; and has caused deep divisions between the global North and South countries.

This division is incongruous with national policies and strategies, which incline to South-South climate technology transfer (SSCTT). Developing country policy documents, as argued in Chapter 5, favour SSCTT as opposed to North-South climate technology transfer (NSCTT). SSCTT is characterized as a technological cooperation based on respect for national sovereignty; national ownership and independence; equality; non-conditionality; non-interference; and mutual benefit. This characterization is seen in policy documents, as well as in the perception of developing country politicians; and is in harmony with the G77+China solidarity spirit in the international climate negotiations. This is where congruence between national level strategies and international climate regime policy was observed. The G77+China alliance was born out of the historical contingency implicit in the principle of 'differentiated responsibilities'.

On the other side of the multi-leveled decision structures, the international climate regime focus on NSCTT, with less attention to SSCTT, is inconsistent with the firm level practices. Key findings from the research analysis in Chapter 6 showed the complementary nature of NSCTT and SSCTT at the firm level, and revealed the relatively greater effectiveness of NSSCTT (North-South-South climate technology transfer) for enhancing climate technology transfer. The research also found ratification of NSSCTT as one important way of strengthening effectiveness of NSCTT and SSCTT complementarity, and ultimately leveraging the best features of the two modalities (NSCTT and SSCTT). The firm level research confirmed that the three modalities of cooperation (SSC, NSC and NSSC)

showed distinct characteristics and resulted in dissimilar level of effectiveness of climate technology transfer.

(2) The research reveals another disjunction between the three levels. The analysis in Chapters 5 and 6 shows that there are few indications of either policy or practices that position, in particular in SSCT, creation of environmental wellbeing as a motivational factor for climate technology transfer at the national and local levels. As indicated in Chapter 4, creating environmental wellbeing is a central goal of international climate technology transfer, but it is not reflected at national and local level decision making structures for climate technology transfer. This could be partly due to the lack of shared vision between the multi-leveled decision-making structures and also due to changes in global economic development and market connections overtaking the historical institutionalism of the UNFCCC.

(3) Negotiations during climate conferences under the UNFCCC have been protracted, and have not led to substantial changes in climate technology transfer that could be transmitted from national strategies through to firm level practices. As the research analysis from Chapter 4 shows, this key challenge for climate technology transfer relates to the polarized, entrenched negotiating positions between the global north and the global south countries, which permeate the atmosphere of international climate negotiations.

(4) The national government of Ethiopia has successfully implemented a policy of creating demand for climate technology transfer, especially in the renewable energy sector. However, in relation to participatory approaches from the bottom-up, the government has not adequately consulted companies in preparation of its policy documents and the technology needs assessment report for the UNFCCC. The lack of genuine and legitimate stakeholder participation and feedback loops (Chapter 5) and the loose network between international companies and local firms (Chapter 6) have, in practice, limited the capacity of bottom-up processes to bring about a convergence between national level climate policy and firm level climate technology transfer actions.

Table 7.1 summarizes the interplay between top-down and bottom-up processes that explains the nature of the relationships between the three decision-making levels. The table is followed by a detail explanation behind the convergences and divergences of firm practices, national policies, and international discourses on climate technology transfer.

TABLE 7.1 SUMMARY OF THE RELATIONSHIPS BETWEEN MULTI-LEVEL DECISION-MAKING STRUCTURES FROM THE ANALYSIS OF TOP-DOWN MACRO POLICY AND BOTTOM-UP MICRO IMPLEMENTATION

Multi-level decision making structures		Points of congruity	Disjunction points
International discourses	<p>Top-down intervention (The effect of international climate policy on national policies and local practices) <u>Key findings from Chapters 4, 5 & 6</u></p>	<p>- G77+China alliance in influencing and guiding the climate technology transfer process at the national level of a developing country.</p>	<p>- The lack of progress in the UNFCCC in ensuring the effective transfer of technologies. - Lack of appropriate instruments to regulate and facilitate SSCTT and NSCTT.</p>
	<p>Top-down intervention (The effect of national policies on local practices) <u>Key findings from Chapters 5 & 6</u></p>	<p>- Creates demand for climate technology transfer.</p>	<p>- Lack of adequate and effective policies for maximizing the net benefits and ensure a “win-win” outcome of the SSCTT.</p>
National Policies	<p>Bottom-up provision (The contribution of national efforts for international climate policies) <u>Key findings from Chapters 4 & 5</u></p>	<p>- Responds to the UNFCCC requests by preparing documents such as Technological Needs Assessment, National Adaptation Program of Action, Program of Adaptation to Climate Change, etc. - The perception that the global south is a partnership of equals among developing country politicians is partly influenced by the spirit of the G77 + China solidarity in the international climate negotiations.</p>	<p>- The policy documents that were submitted by national governments to the UNFCCC did not reflect the actual technology transfer practices of the country.</p>
	<p>Bottom-up provision (The implications of local practices in shaping national policies and influencing international climate policy discussions) <u>Key findings from Chapters 5 & 6</u></p>	<p>- Responds to the market created by the national policies and strategies. - Creating environmental wellbeing has not been a priority as a driving factor for SSCTT both in national strategies and local level practices.</p>	<p>- The alliance structure at the international climate policy negotiations and the political solidarity of the SSC at the national level has little effect at the local level. In addition, contrary to UNFCCC aims, creating environmental wellbeing is not a motivational factor for climate technology transfer in SSCTT at the firm level. - The lack of genuine and legitimate stakeholder participation and feedback loops.</p>

7.1.2 CLIMATE TECHNOLOGY TRANSFER AT THE INTERNATIONAL AND NATIONAL LEVEL

Key accords: The research demonstrated that harmonization between national and international levels centered mainly on two aspects: (1) inspiration from, and influence of, the G77+China alliance in the climate technology transfer process at national level of a developing country. The other aspect is (2) the developing country government's response to the demands of global climate policy under the UNFCCC. Governments have been preparing documents such as the Technological Needs Assessment, National Adaptation Program of Action, Program of Adaptation to Climate Change, and other documents in response to the UNFCCC calls. International technology transfer in these national documents as well as in the UNFCCC is framed as a technology flow from the global North to the global South countries. However, results presented in Chapter 5 show that in practice, technological cooperation of LDCs (least developed countries) such as Ethiopia with developed countries is diminishing and is being overtaken by the global south. This indicates that country documents submitted by national governments to the UNFCCC in response to the Convention request, sometimes do not reflect the actual technology transfer practices in a country.

Key disjunction points: Congruence between the two decision making structures, the international and national level, was dampened by the following two elements: (1) in least developed countries, like Ethiopia, technological cooperation with emerging economies represents a south-south dialectic relation, which is taking place in an emerging new global economic configuration marked by a technology gap. The country-level technological cooperation with developed countries is diminishing and being overtaken by the global south. In contrast to the growing SSCTT, the UNFCCC is still governed by the principle of 'differentiated responsibilities', which is characterized by the North-South technology transfer. (2) There is not a coherent or comprehensive international framework for the new phenomenon of South–South technology transfer under the UNFCCC. This is partly because the international climate regime under the UNFCCC falls short of sufficiently considering the potential of south-south technology transfer. International frameworks could have harnessed the potential of SSCTT in order to stimulate greater technological growth in the developing world.

Implications for good accord: The following issues could be considered to enhance harmonization between international and national level decision making structures. (1) The relevance of technology transfer, not only from a climate perspective but also from a development view, underlines the need to develop appropriate legal and financial

mechanisms. These components will support and encourage the diffusion of mitigation and adaptation technologies between developing countries. It is in the interests of the entire international community to adopt appropriate instruments to regulate and facilitate South–South exchange of climate-related technologies, and thereby make a significant contribution to more effective environmental well-being in conjunction with stable, long-term domestic economic growth. (2) There should also be a quality check for national documents prepared in response to the UNFCCC.

7.1.3 CLIMATE TECHNOLOGY TRANSFER AT THE NATIONAL AND LOCAL LEVEL

Key accords: The following two points could explain the good compliance between national climate technology transfer strategies and local practices. (1) Transfer of climate technologies depends on successful implementation of policies that could create demand for such climate technologies. Governments of least developing countries such as Ethiopia have created demand for climate technologies in particular in the energy sector. As a result, foreign direct investment is on the rise, and FDI from other developing countries is at the forefront of this trend. Companies from other developing countries have been establishing industrial parks and training schools to facilitate their long-term engagement, technology transfer and business development. (2) The government of Ethiopia, as is the case in many other developing countries, is in the process of building and strengthening state owned companies. As a result, technological cooperation in SSCTT at the firm level is dominated by state-owned enterprises (for example, between Ethiopian state owned companies and other developing countries, mainly Chinese, state owned enterprises).

Key disjunction points: The good congruity between national level climate policy and firm level climate technology transfer practices is hampered by at least three factors: (1) The lack of genuine and legitimate stakeholder consultation during the Technological Needs Assessment and preparation of other country documents. This in turn, limits the contribution of stakeholders' perspectives, which could have led to the development of a shared vision to progress the climate technology transfer agenda. (2) National policies inclined more to south-south cooperation for promoting transfer of climate technology transfer; whereas findings from the firm level research analysis reconfirms SSCTT as a complement to NSCTT rather than a substitute. (3) In contrast to national government ambition to enhance local company capacity through international technology cooperation, the research revealed that in SSCTT there are limited linkages of global companies to local enterprises, and this negatively affects effectiveness of climate technology transfer. This made technology transfer from the global south less effective compared to technology flow in NSCTT and NSSCTT.

Implications for good accord: The following two points could be considered to strengthen congruity between national and local level decision-making structures. (1) In order to make international climate technology transfer effective in developing countries, stakeholder participation and feedback loops should be emphasized. Companies as key stakeholders need to be consulted to prepare them for possible technological changes, to facilitate their participation in decision-making and to establish shared vision. (2) There is a clear market failure in the degree and form of mobilization of the local networks and the way they are connected with global south companies. In the event of this kind of market failure there should be policy intervention by both national and international governance systems to enhance the quality of relationships between global and local companies.

7.1.4 CLIMATE TECHNOLOGY TRANSFER AT THE LOCAL AND INTERNATIONAL LEVEL

Key accords: The role of the private sector (firm level) in climate technology transfer and implementing innovative solutions in energy efficiency, carbon management and climate technologies has been recognized in international climate policy discourses. Local entities, including the private sector, have been attending climate policy discussions under the UNFCCC to understand current thinking on the issues, and to ensure that they can help their clients tackle the risks associated with the consequences of climate change. Despite the number of meetings among subnational entities and private sector communities at climate conferences, COPs decisions and agreements and nation-state implementation pledges, have focused at the national-level. That disconnect raises broader questions about whether the UNFCCC process should be changed, either formally or informally, to include subnational and local networks more fully.

Key disjunction points: In the international climate policy discussion under the UNFCCC, leveraging of private finance through public finance and the general trend from regulatory approaches to market-based methods are controversial issues. Leading to a heated debate on market-based versus non-market based technology transfer. The research in Chapter 6 showed a market-led mechanism as the primary means of climate technology transfer.

However, the findings in Chapter 5 showed markets for climate technologies were created mainly by significant government interventions through regulatory mechanisms and 'mega projects'. The mixed role of the government in setting rules for the market, being a market player through its enterprises, and as a source of finance, has created confusion and frustration at the firm level. If market-based solutions for climate technology transfer were defined by international climate policies, those problems would have better chances of being

reduced. It is perhaps because of the lack of international policies and clear mechanisms, that the discourses and efforts of international discussions under the UNFCCC, in one way or another, have not been felt at the firm level. Technology transfer under the UNFCCC remains biased towards the national scale, despite recognition of private-sector activity as being key in technology transfer; and the holding of private sector meetings at international climate conferences under the UNFCCC. By its very nature the UNFCCC treats international law for climate technology transfer as a matter that can only be handled at national scale. There is no well-defined structure under the UNFCCC for tapping into private expertise, and to take due account of private stakeholders' interests in the UNFCCC context. In consequence, there is little effective and formal private sector engagement within the international climate change policy development and implementation process.

Implications for good accord: The treatment of nation-states as core units in the UNFCCC conforms with international law, which views nation-states as its primary subjects and objects. However, the research underscores the need for engaging local entities, such as the private sector, at international climate policy discussions. A formal engagement would create a more informed debate at the UNFCCC, effective implementation of the international climate policy for technology transfer and re-centering the international climate policy to micro-level structures. This leads to the following recommendations for a better linkage between the international and firm level transfer of climate technologies. (1) Documents submitted to the UNFCCC by national governments should consider the interest, needs, and capabilities of micro-level structures, like firms and companies. (2) The international climate policy under the UNFCCC should have policies that support the technology supply, as well as technological learning, on the recipient side. (3) Firm level climate technology transfer needs international policy to encourage cooperation among firms. To encourage cooperation there is a need to have effective and formal private sector engagement within the international climate change policy development and implementation process.

7.2 GENERALIZATION OF FINDINGS INTO OTHER CONTEXTS

The results obtained on the relationships between the multi-leveled decision structures for climate technology transfer can be extrapolated to other developing countries in particular to LDCs. In addition, the findings have direct validity to other COPs (Conferences of the Parties) under the UNFCCC as they are also governed by the principle of 'differentiated responsibilities' situated along the North-South axis. Therefore, generalization of the empirical results in this thesis can be made for both of these dimensions.

(1) Validity to other developing countries: Least developed countries positions, preferences and bargains for climate technology transfer under the UNFCCC was similar and they were responding to the UNFCCC calls such as conducting Technological Needs Assessments, National Adaptation Program of Actions, and others. LDC relationships, and level of interconnections to the international climate policy under the UNFCCC, were comparable. In addition, south-south cooperation as a new technology transfer paradigm for international climate technology transfer is occurring in many developing countries.

(2) Validity to other Conferences of the Parties (COPs): As key findings from the Chapter 4 research illustrate, the Copenhagen conference (COP 15) set in motion particular negotiating strategies and positions that are relevant to the ongoing process and COPs including COP 16, COP 17 and COP 18. The historical contingency implicit in the principle of 'differentiated responsibilities' has caused COPs to be characterized by deep divisions between the classically defined global North and South countries.

7.3 OUTLOOK AND FUTURE RESEARCH

Each chapter of the thesis in particular Chapters 4, 5 and 6 highlights some areas of future research. Nevertheless, there are particular strands of future inquiry that are emphasized in this section. New questions can be set out, with the results from this research as a starting point for expanding the breadth and depth of this work.

Firstly, the qualitative analysis is limited by the study of a single country, Ethiopia. While this provided good insights into the different challenges faced by developing countries, it still provides a partial view of the developing world, given the particular characteristics of emerging economies, mainly their good economic performance and strong institutions. More case studies are required to reflect the diversity of challenges faced by different developing countries. The thesis looks at the transfer of climate technologies from emerging economies to least developed countries. This neglects the fact that the nature and characteristics of technology transfer within emerging economies will differ in the national and local context. An extension of this thesis to case studies from emerging economies would thus be necessary to conduct a comparative study of technology transfer among developing countries.

Secondly, the thesis deals with the international arena of climate change negotiations under the UNFCCC by focusing on the Copenhagen conference. Incremental changes and adjustments have occurred in international climate policy discussions since the Copenhagen conference. These changes are mainly:

(1) A split among the G77/China groups in particular the divide between BASIC countries (Brazil, South Africa, India and China), and least developing countries was observed in Copenhagen, but was more evident in the latter COPs. This could herald the beginning of a process of blurring the developed/developing country distinction, despite the observed divergent and often conflicting preferences persisting among countries because of the principle of 'differentiated responsibilities'. At the time of this research, the split among developing countries was just emerging and the extent of the split was not clear.

Perhaps the time has come for innovative proposals for future international climate-policy architecture, not for incremental adjustments to the old pathway. The incremental changes on climate technology transfer institutions might serve as incentives to mobilize coalitions behind the need for changes on the major sticking point of international climate bargaining: the principle of 'differentiated responsibilities'. Change on the first generation decision could usher in profound institutional transformation in the realms of international climate technology transfer. If the gap between developing and developed countries closed, a shift in the negotiating dynamic may become apparent. As a result, there could be a chance to change the major sticking point of the international climate bargaining: the principle of 'differentiated responsibilities'. Any future change in the principle of 'differentiated responsibilities' could be a game changer in the international climate policy discourse.

(2) The second incremental changes were on institutional arrangements for climate technology that include establishment of a Technology Mechanism, a Copenhagen Green Climate Fund, and a High Level Panel. At the time of this research for the thesis, it was too early to see how the creation of the new Technology Mechanism enhances the transfer of climate-friendly technologies, particularly to developing countries. The Mechanism is composed of two main bodies: the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN). In addition, at the time of this research, the institutional set-up of Technology Mechanism, its link with the Green Climate Fund (GEF), and how it would influence the relationship of the multi-leveled decision structures for climate technology transfer, was not clear. Moreover, at the time of writing of this thesis, the Green Climate Fund, which was expected to establish a window for technology transfer, had not come into effect.

The GCF was formally established at COP 16 as an operating entity of the financial mechanism of the Convention. At COP 17 a governing board was established, and the Republic of Korea as a host country of the Fund was chosen at COP 18. In order to enforce actual change on the ground, and make an informed decision at the GCF board level, a

group of academicians had suggested that the board combine its top-down approach with a bottom-up operation mechanism through a multi stakeholder process. This suggestion, if implemented, may enhance congruity between the three-levels of decision structures.

7.4 REFLECTION ON METHODOLOGY

Research on the multi-leveled decision structures for climate technology transfer requires a multidisciplinary background, including international climate politics, development and technical backgrounds. This requires the research to have a wide general knowledge, but also be able to focus this broad background through specific methodological techniques. Entry into the research domain of international climate technology transfer is challenging, tedious, and simply quite difficult. The main reason for this difficulty was the political sensitivity of international technology transfer, in particular at the international level under the UNFCCC. Data collection for the international level of the thesis was made in 2010, immediately after the Copenhagen climate conference. Government representatives were not willing to reveal and discuss their actual positions outside negotiation rooms.

In addition, the political atmosphere in Ethiopia during the fieldwork period was very tense due to the Arab uprisings. To obtain cooperation of respondents, and retrieve government data, required emphasizing the political neutrality of the research work, but this took substantial time and energy. For example, locating appropriate participants involved a great deal of explanation, meetings, referrals, calls and approval processes. The political atmosphere in the country prompted revision of the questionnaire due to political sensitivity of some of the research questions and confidentiality of information. In a country like Ethiopia, where there is restriction on freedom of expression, people are not willing to make comments on the country's political positions and policy documents. In addition, there was a need to probe beyond the surface of policy documents, since documents such as the Technological Needs Assessment, National Adaptation Program of Action, Program of Adaptation to Climate Change policy do not fully represent the actual positions of the country.

The researcher was fortunate to have privileged access to higher government officials in climate conferences and other high profile related international conferences, for example, he had the chance to meet and conduct interviews (especially unstructured interview) with higher government officials in Bonn, Addis Ababa, Brussels, Washington, Cape Town, Brasilia, Beijing, Istanbul, Cairo, Abu Dhabi, Mauritius and Oslo. The researcher effectively used his contacts at the secretariat (UNFCCC) in Bonn, various ministerial offices in Addis Ababa, and other countries, to gain access to organizations and increase participation in the

research project. It was through his contacts that data were effectively collected and data validity was strengthened.

In addition, the application of an iterative explanation building analysis technique through early and continual analysis, facilitated collection of better quality data. This was conducted by cycling through old and new data, adjusting tactics and even strategies based on preliminary findings.

7.5 SIGNIFICANCE AND CONTRIBUTION OF THE RESEARCH

The findings of this research on the mixed coherence and incoherent relationships of the multi-leveled decision structures for climate technology transfer could help facilitate negotiations on international climate policy, improve the quality of national policies, and improve the transfer of climate technologies at the firm level. The empirical evidence presented could enable negotiators, policy makers and practitioners better understand the reciprocal nature of the climate technology transfer processes; and the intense interplay between top-down and bottom-up processes.

The research contributes to filling knowledge gaps on understanding the comprehensive and broader notion of climate technology transfer. Prior work on climate technology transfer focused on analyzing specific mechanisms or specific institutional contexts of technology transfer at a specific level of decision-making structure, which is inadequate for understanding the big picture of climate technology transfer. This thesis provides information on the synergies of decision-making structures that result from analysis of socio-political and technical factors at different scales and shows how the different entities intervene and influence the decision-making processes.

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APPENDICES

APPENDIX A

TECHNOLOGY TRANSFER EFFECTIVENESS IN THE SOUTH – SOUTH COOPERATION MODALITIES

QUESTIONNAIRE (ORIGINAL)

The aim of this research is to advance the understanding and rationalization of climate technology transfer in Ethiopia. The paper is confined to the analysis of climate investments originated from other developing countries to Ethiopia, which have the potential for the transfer of climate technology transfer. The ultimate objective of the study is to assess the effectiveness of the south-south cooperation modality in expanding opportunities for the transfer of climate technology transfer.

General Information

Respondent Name

Position

Department

Organization

Email

Office Tel

Fax

Year Established

Section 1: Organization size, focus and organizational culture

1. What are the major three activity fields your company is focusing on?

2. What is the type of ownership of the company?
 - A. Wholly owned Foreign Corporation
 - B. Joint venture

If it is the latter, what is the percentage of domestic capital and foreign capital?

3. What is the amount of sales by product?
Annual sale volume (in USD)
Product (A) ----- Product (B) ----- Product (C) -----
4. What is your company's Rate of Investment? Use this formula: $ROI = \frac{(\text{Gain from Investment} - \text{Cost of Investment})}{(\text{Cost of Investment})}$
5. Your organization runs its business through a culture of:
 - A. Managing Leading
 - B. Performance oriented
 - C. Success oriented

Section 2: Sources and Level of Technology Transfer

6. What are your sources of technology transfer?
 - A. Joint venture
 - B. Foreign Direct Investment
 - C. Total process contracting
 - D. Technical consultancy contracts
 - E. Purchasing machinery supplies
 - F. Employment of experts
 - G. Others, (Please indicate strategy):
7. What is the number of technology transfer projects currently underway that should diffuse unavailable technology in the organization?
8. What is the number of licenses signed for external technology in the past three years?
9. Rate the success of the new technology at meeting its intended requirements.
 - A. Success
 - B. Partial success
 - C. Failure
10. How do you rate the efficiency of the organization information scanning systems?
 - A. Optimal
 - B. Advantageous
 - C. Useful
 - D. Not useful
11. What is the percentage of new products using technology developed outside the organization?

12. How do you rate your technological advancement compare to the current state of art across the world?
- A. Latest technology B. Average C. Ordinary
13. What makes your technology different from the technologies being used in other similar industries in Ethiopia?
14. There are several factors that hinder the process of technology transfer or cause projects to fail. Please select those that you think are a barrier to your business and rank them top-down.
- A. Lack of awareness: many organizations are not aware of available technology.
 - B. Lack of knowledge: if an organization is short of skills and knowledge, it may be unable to use the technology offered.
 - C. Lack of funds: organizations may be unable to purchase or develop technology.
 - D. Lack of common interest: organizations may exhibit a lack of motivation to reach agreement or settle differences of opinions about available options.
 - E. Conflict of interest: competing organizations may be unwilling to collaborate.
 - F. Poor coordination: individuals within an organization or collaborating organizations fail to effectively coordinate about activities, processes, goals and directions of the venture.
 - G. Lack of resources: this can include both physical resources and loss of a key member.
 - H. Lack of time.
 - I. Lack of trust.
 - J. Technical problems
 - K. Organizational problems, Management attitudes
 - L. Resistance to change
 - M. Poor information flow
 - N. Weak links between customers and suppliers
 - O. Cultural differences
 - P. Geographic difference
 - Q. Legal constraints
 - R. Administrative burdens

Section 3: Absorptive Capacity

15. List the number of employee with respect to their qualifications in the table below.

	Education Level	Number of employees
A	PhD degree	
B	Masters Degree	
C	Bachelor Degree	
D	Diploma	
E	Vocational School Diploma	
F	High School Secondary Level	
G	Below High School	
H	No qualifications	

16. What percentage of trainings is external?

17. What is the main objective of internal and external trainings?

18. Is employee performance review is the base for selecting a training program for the employee?

19. How often and in what format training is provided to the employees?

20. How the trainings are relevant to employee job and her/his level of expertise?

21. How after such training, employees immediately put what they learned into action?

22. How do you evaluate their satisfaction level to the trainings?

23. What are the main contents of the trainees' evaluation reports after each training programme?

24. What is the average training expenditure per employee?

25. Technology absorptive ability adopted is:

A. Adaptation

B. Application

C. Production

26. What percentage of your employees has access to the Internet from their desks?

A. 100%

B. 75%- 99%

C. 50%-74%

D. 25%-49%

E. 10%-24%

F. Less than 10%

27. If your organization uses the internet, do you use it for
 A. Email B. Technical and Marketing Research C. Selling
28. Does your organization have a homepage site on the internet?
 A. Yes B. No
29. What is the technology diffusion channel?
 A. Formal B. Informal
30. What is the interaction mechanism for the technology mechanism?
 A. Intra-organization B. Inter-organization
31. Does your organization allocate any resources (funds, time or effort) to research and development (R&D)?
 A. Yes B. No
32. What is the main source of research and development?
 A. Human resources
 B. Ambitious of R&D staff
 C. Experience Staff
 D. Administrative support
33. What percentage of research is classified as having some degree of commercial viability?

Section 4: Value Networks

34. How many cooperative agreements do you have with?

	Organization Type	Number of cooperative agreements
A	Small and Medium Enterprises	
B	Larger Organizations	
C	Other R&D institutions	

35. If your organization engages in cooperative agreements, please indicate the level reached with each agreement between your organization and the overseas or local research and development (R&D) institution.
- A. Little communication Cooperation
 - B. Formal communication and exchange of information Coordination
 - C. Shared information and decision-making Coalition
 - D. Shared resources and frequent prioritized communication Collaboration
 - E. Members belong to one system and census is reached on all decisions
36. What variables, properties, or constraints might be affecting a participant's ability to create or add value?

THANK YOU FOR YOUR COOPERATION IN COMPLETING THE QUESTIONNAIRE.

APPENDIX B

INTERVIEW QUESTIONS

1. Would you please tell me some of the Ethiopia policies that promote the transfer of climate technologies? How these policies encourage the provision of direct financial support like grants, subsidies, provision of equipment or services, loans and loan guarantees and indirect financial support, like investment tax credits?
2. How can current legal legislation be improved to improve continual technology transfer and adaptation particularly private-sector-driven pathways?
3. How do you evaluate the current Ethiopia property rights infrastructure in enhancing technology transfer? What are the major limitations in the national frameworks for intellectual property protection? What should be done to overcome these barriers?
4. What is the total number of patents generated per year? What is the number of patents generated in climate technologies?
5. What are the main countries of origins for technology transfer in Ethiopia? (please list the first five countries)
6. What are main sources of technology transfer in Ethiopia?
 - A. Joint venture
 - B. wholly owned subsidiaries
 - C. Total process contracting

D. Technical consultancy contracts purchasing machinery supplies Employment of experts licensing agreements

E. Coproduction research and development (R&D) agreements

F. Personnel exchanges

G. Information transfers from documents and conferences,

H. Others, (Please indicate strategy)

7. Among the main sources of technology transfer indicated above, which are more common for technologies originated from developing countries like India and China to Ethiopia?

APPENDIX C

CONTROL VARIABLES SCORING SHEET: MESSEBO PROJECT

Control variables	A		B		C		D		E		F		G	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Allying Relative Size	3	1	5	2	4	3	7	5	-3	4	6	4	-4	-6
Industry Mix	2	3	4	1	6	4	7	7	1	2	5	5	3	-6
Alliance Age	4	2	5	3	6	5	7	7	-2	-6	3	4	1	-3
Shadow of the Future	3	5	4	2	2	3	5	4	-4	-1	6	7	3	5
Institutional Tension	5	2	2	3	3	4	6	7	-4	-5	1	4	-7	-6
Mean Average	3.4	2.6	4	2.2	4.2	3.8	6.4	6	-2.4	-1.2	4.2	4.8	-0.8	-3.2

APPENDIX D

CONTROL VARIABLES SCORING SHEET: ASHEGODA PROJECT

Control variables	A		B		C		D		E		F		G	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Allying Relative Size	2	5	4	3	3	6	7	7	4	3	-4	5	5	5
Industry Mix	2	4	3	2	4	5	7	6	6	5	-1	3	5	7
Alliance Age	4	4	2	3	6	6	4	5	2	5	3	6	7	7
Shadow of the Future	6	6	5	4	3	2	5	4	6	6	4	5	7	7
Institutional tension	2	3	3	4	4	4	5	5	4	5	-5	2	3	4
Mean Average	3.2	4.4	3.4	3.2	4	4.6	5.6	5.4	4.4	4.8	-0.6	4.2	5.4	6

APPENDIX E

CONTROL VARIABLES SCORING SHEET: NAZRETH PROJECT

Control variables	A		B		C		D		E		F	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Allying Relative Size	2	4	1	2	1	3	3	3	-2	4	5	5
Industry Mix	3	3	1	2	2	4	2	3	-1	3	5	7
Alliance Age	4	3	-2	-1	2	4	-3	-1	-1	2	7	7
Shadow of the Future	3	4	3	4	3	4	-2	4	-1	2	7	7
Institutional tension	3	3	2	3	3	4	-4	3	-3	2	3	4
Mean Average	3	3.4	1	2	2.2	3.8	-0.8	2.4	-1.6	2.6	5.4	6

SUMMARY

This thesis examines the relationships between multi-leveled decision structures for climate technology transfer through an analysis of top-down macro-policy and bottom-up micro-implementation. It examines how international climate technology transfer policy under the UNFCCC filters down to the national policies that govern the micro entities, such as firms and companies. Similarly, the thesis examines how climate technology transfer practices at the firm level are reflected in national strategies and molded by international climate policies.

Specifically, the thesis addresses the research question: what is the relationship between firm practices, national policies, and international discourses for climate technology transfer, and if there is a disjunction, then why? In order to analyze these relationships, the thesis locates technology transfer as a response to climate change at the interface between three factors: (1) technology transfer issues that have always been at the forefront of the global climate change debate (2) the objective of technology transfer for achieving low-carbon climate resilient national socio-economic development aspirations and (3) the effectiveness of technology transfer at the firm level in decreasing GHG emissions.

The thesis concludes by addressing the research question of whether the three levels (international, national and local) are more weakly coupled than is needed for effective climate technology transfer. The loose interconnections between the three levels in the intense interplay of top-down and bottom-up processes have resulted in a mixture of coherent and incoherent relationships between the three levels. Results from combining top-down macro-policy analysis (mainly in Chapters 4 and 5) with bottom-up micro-implementation analysis (mainly in Chapter 6) reveal the existence of the different level of coherence between the multi-leveled decision structures for climate technology transfer. The research shows that there is a relatively sound accord between international climate technology transfer discourses under the UNFCCC and national technology transfer policy. There is also good congruity between national policy and firm-level climate technology transfer practices. However, there is a clear disjunction between the international and local level.

A qualitative explanatory research method, including a combination of case study, survey, and observation research methods, was employed to answer the research questions. The data

analysis followed a process of “iterative explanation building,” and analysis in each unit took place concurrently with data collection. In order to trace linkages between the three levels of analysis (international, national, and firm levels), each research chapter (Chapters 4, 5 and 6) relates findings to the other levels of analysis. Linking of the three levels of analysis was done to trace possible causal links and to reveal the holistic picture of climate technology transfer.

The thesis employed a combination of theories and schools of thought as a framework for examining the processes of multi-level international climate technology transfer. The research first drew on historical institutionalism to investigate causes for the lack of ambitious international climate technology transfer agreements. It also employed international regime theory, most notably its three core concepts— power, interest and knowledge—to explain the basic problems in global climate negotiations and to examine the asymmetry in parties’ interests and demands for climate technology transfer under the UNFCCC. The research also took advantage of pertinent insights from development theorists to investigate whether and how countries’ development approaches accelerate the transfer of climate technologies. This research also employed the methodologies of actor-network theory (ANT) and the theory of absorptive capacity (TAC) to examine effectiveness of technology transfer at the firm level. The combination of these two perspectives highlights issues of information access and assimilation.

The first component (Chapter 4) of the research chapters (Chapters 4, 5 and 6) investigates the reasons for difficulties in developing a concrete international policy on climate technology transfer. It examines the origin and structure of countries’ incompatible preferences and bargains under the UNFCCC. It also provides insights for exploring the reasons for accords and disjunctions that could exist between international climate technology transfer debates under the UNFCCC, national policies and priorities for ‘climate-smart’ institutions (discussed in Chapter 5) and the effectiveness of technology transfer at the firm level (discussed in Chapter 6). Chapter 4 specifically examines the substance and processes of the 2009 Copenhagen Climate Conference negotiations and reviews policy positions of countries on international environmentally sound technology transfer as a climate change mitigation and adaptation mechanism. It examines what the outcome might mean for facilitating international transfer of climate technologies, and investigates causes for the lack of ambitious international climate technology transfer agreements. This part of the research demonstrates that once an agreement has been negotiated between a large numbers of countries, it is hard to change paths due to inbuilt inflexibility in the prior establishment of an international institutional arrangement. Chapter 4 concludes that causes for the deep divisions between the global North and South countries,

and the reasons incompatible preferences persist, lie not in the absence of shared norms (e.g. the importance of combating climate change), but rather in the historical contingency implicit in the principle of “differentiated responsibilities.” This was first apparent in the Byrd-Hagel resolution, which effectively paralyzed the Kyoto Protocol. The principle of differentiated responsibilities, dating from the birth of the UNFCCC, was a major sticking point in Copenhagen and in subsequent meetings preventing concrete forward movement in the international climate policy negotiations. The historical institutionalism implicit in the principle of ‘differentiated responsibilities’ of the international climate policy under the UNFCCC has led to such a simplistic view of technology transfer as “North-South.” However, evidence from Chapter 5 challenges the traditional characterization of developed-developing, north–south transfer as the major form of technology transfer.

The research findings from Chapters 4 and 5 demonstrate that the harmonization between the national and the international level is centered mainly on two aspects: the inspiration from, and influence of, the G77+China alliance in international climate policy under the UNFCCC is reflected in the climate technology transfer process at the national level of a developing country. The other aspect is the fact that developing country governments have been attempting to shape and reshape their national policies in response to the demands of global climate policy under the UNFCCC, even though these changes in national policies are not substantive enough.

The national level component of the thesis (Chapter 5) emphasizes the role of developing countries as sources, as well as recipients, of international technology innovations. Despite wide recognition of the economic advancement and technological sophistication of particular developing countries, these changes in relation to international technology flow have received relatively little attention in academic research and have no coherent international policies under the UNFCCC. Chapter 5 of the thesis analyses the potential, characteristics, and relevance of south-south cooperation as the new technology transfer paradigm for international environmentally sound technology transfer, emphasizing the role of developing countries as both sources and recipients of technology innovations. The evidence for this part of the thesis on the South-South climate technology transfer (SSCT) came from analyzing the case of Ethiopia. The evidence indicates that technological cooperation of least developing countries (LDCs), such as Ethiopia, with developed countries is diminishing and is being overtaken by cooperation with the global south.

However, the research concludes that SSCT is not an alternative to NSCTT; rather, it is an important adjunct to North-South cooperation aimed at promoting the flow of technology to developing countries. The research did not find indications from policies or practices that environmental wellbeing is a motivational factor for south-south climate technology transfer. Neither was political solidarity of the global south countries in international climate regimes a major motivating factor for south-south climate technology transfer. Evidence from the chapter demonstrates that in south-south climate technology transfer there is also lack of support for improvement of the transferee's institutional infrastructure, and the rise of state capitalism has limited the private sector's involvement as an engine of innovation. In addition, limited interaction of local firms on the supply chain, and limitations in reversing the unfair North-South trade relationship, characterize south-south climate technology transfer. These limitations highlight the need for adequate and effective policies for maximizing the net benefits of transferees and ensuring a "win-win" outcome of the technological cooperation. Transfer of climate technology from the global north countries to the south, as discussed in Chapter 4, characterizes the international level climate policy under the UNFCCC. This is incongruent with national policies and strategies, which incline to SSCTT. Developing country policy documents, as argued in Chapter 5, favour SSCTT, as opposed to NSCTT. SSCTT is characterized as a technological cooperation based on respect for national sovereignty; national ownership and independence; equality; non-conditionality; non-interference; and mutual benefit. This characterization as seen in policy documents, as well as in the perception of developing country politicians, is in harmony with the G77+China solidarity spirit in international climate negotiations. This is where the concurrence between the national level strategies and the international climate regime policy was observed. The G77+China alliance was born out of the historical institutionalism implicit in the principle of "differentiated responsibilities." Implementation of national policies at the local level in the context of international negotiations is studied in Chapter 6 of the thesis. This chapter addresses limitations of existing literature in providing details about the broader picture of climate technology transfer through empirical evidence from smaller-scale units, and the limitations of studies that look at the perspective of actors involved in actual climate technology transfer activities. As a continuation of the national level analysis (Chapter 5), the firm level study also analyzes the case of Ethiopia as a host for technology transfer with other developing countries, as well as developed countries, as sources. Three projects in Ethiopia were selected as case studies to examine climate technology transfer as an emerging phenomenon and to assess the effectiveness of technology cooperation modalities in promoting it.

The thesis examines the effectiveness of North-South (NSCTT), South-South (SSCTT) and North-South-South (NSSCTT) climate technology transfer through the prisms of a firm's ability to access information and its ability to utilize knowledge obtained from external sources. It compares these three modalities of cooperation and gauges their effectiveness for enhancing technology transfer at the firm level. It investigates the effectiveness of climate technology transfer at the firm level in terms of the distinct and combined effects of the firm's network and absorptive capacity for climate technology transfer.

The research question for this component of the research is: "How effective are the international cooperation modalities (SSCTT, NSCTT and NSSCTT) for enhancing transfer of climate technologies at the firm level?"

The three modes of cooperation (SSCTT, NSCTT and NSSCTT) show distinct characteristics and result in dissimilar levels of effectiveness in technology transfer. Technological capacities occur in all three modes of cooperation but at different levels. The results show the complementary nature of NSCTT and SSCTT and endorse NSSCTT as an important way of strengthening effectiveness of this complementarity and fostering technology transfer because it combined the comparative advantages of both SSCTT and NSCTT. Results from analysis at the national (Chapter 5) and firm level (Chapter 6) show that there is congruity between national climate technology transfer strategies and local practices. This can be explained by the fact that governments of least developing countries, such as Ethiopia, have created demand for climate technologies at the firm level through their national policies and strategies. In addition, national policy inclines towards state capitalism (the "developmental state") and this is reflected in the focus of developing country governments like Ethiopia on building and strengthening state-owned companies. As a result, technological cooperation in the SSCTT at the firm level is dominated by state-owned enterprises (for instance, between Ethiopia's state-owned companies and another developing country, mainly China's state-owned enterprises). However, congruity between national level climate policy and firm level climate technology transfer practices is impeded by certain factors. For example, contrary to national government ambitions to enhance local company capacity through international technology cooperation through SSCTT, the research revealed that in SSCTT there are limited linkages between global companies and local enterprises, and this lack of connection negatively affects effectiveness of climate technology transfer. This makes technology transfer from the global south less effective, compared to technology flow in NSCTT and NSSCTT.

On the other side of the multi-leveled decision structures, the international climate regime focus on NSCTT (Chapter 4), coupled with less attention to SSCTT, is inconsistent with results from the firm level study (Chapter 6), which showed the complementary nature of NSCTT and SSCTT at the firm level and revealed the relatively greater effectiveness of NSSCTT.

SAMENVATTING

In dit proefschrift worden de relaties tussen meerlagige besluitvormingsstructuren voor de overdracht van klimaattechnologie bestudeerd aan de hand van een analyse van het top-down macrobeleid en de bottom-up micro-implementatie. Onderzocht wordt hoe internationaal beleid inzake de overdracht van klimaattechnologie in het kader van het United Nations Framework Convention on Climate Change (UNFCCC) doorwerkt op nationale beleidsmaatregelen ten aanzien van micro-entiteiten (zoals ondernemingen). Tegelijk wordt bestudeerd hoe de praktijken ten aanzien van de overdracht van klimaattechnologie op bedrijfsniveau hun weerslag vinden in nationale strategieën en hoe ze worden vormgegeven op basis van internationale klimaatbeleidsmaatregelen.

Het proefschrift richt zich met name op de volgende onderzoeksvraag: wat is de relatie tussen de bedrijfspraktijken, de nationale beleidsmaatregelen en het internationale debat over de overdracht van klimaattechnologie, en als deze niet in overeenstemming zijn – wat is de reden daarvan? Om deze relaties in kaart te brengen, wordt technologieoverdracht als een respons op klimaatverandering in dit onderzoek beschouwd op het grensvlak van drie factoren: (1) kwesties met betrekking tot technologieoverdracht in het mondiale debat over klimaatverandering die altijd al een prominente rol hebben gespeeld; (2) het doel van technologieoverdracht ten behoeve van het verwezenlijken van de nationale ambities op het vlak van koolstofarme, klimaatveranderingsbestendig sociaal-economische ontwikkeling; en (3) de doelmatigheid van technologieoverdracht op bedrijfsniveau wat betreft de vermindering van de emissie van broeikasgassen.

Tot slot richt het proefschrift zich op de onderzoeksvraag of de verbanden tussen de drie niveaus (internationaal, nationaal en lokaal) zwakker zijn dan eigenlijk nodig is voor een effectieve overdracht van klimaattechnologie. De losse onderlinge verbanden tussen deze drie niveaus binnen het intensieve samenspel van processen van boven- en onderaf hebben geresulteerd in een mix van coherente en incoherente verbanden tussen deze niveaus. Als we de resultaten van een analyse van het top-down macrobeleid (zie met name de hoofdstukken 4 en 5) naast die van een analyse van de bottom-up micro-implementatie (zie met name hoofdstuk 6) leggen, blijkt dat er verschillende maten van samenhang bestaan tussen de meerlagige besluitvormingsstructuren voor de overdracht van klimaattechnologie. Het onderzoek geeft aan

dat het internationale debat over de overdracht van klimaattechnologie in het kader van het UNFCCC en het nationale beleid inzake technologieoverdracht relatief goed overeenkomen. Ook is er een goede overeenstemming tussen nationaal beleid en de overdrachtspraktijken van klimaattechnologie op bedrijfsniveau. Er is echter een duidelijk gebrek aan afstemming tussen het internationale en het lokale niveau.

Om een antwoord te formuleren op de onderzoeksvragen is een kwalitatieve verklarende onderzoeksmethode toegepast, met inbegrip van casestudy's, enquêtes en waarnemingen. Bij de gegevensanalyse is uitgegaan van een proces van 'iteratieve explicatieopbouw'. Van elk onderdeel vond de analyse tegelijkertijd met de gegevensverzameling plaats. Om de verbanden tussen de drie onderzoeksniveaus (internationaal, nationaal en bedrijfsniveau) na te gaan, zijn in elk onderzoekshoofdstuk (hoofdstukken 4, 5 en 6) de bevindingen gerelateerd aan de overige onderzoeksniveaus. Het koppelen van deze drie onderzoeksniveaus is gedaan om mogelijke causale verbanden te traceren en om een allesomvattend beeld te krijgen van de overdracht van klimaattechnologie.

In het onderzoek is gebruikgemaakt van een combinatie van theorieën en denkwijzen als kader voor het beoordelen van de processen voor meerlagige internationale overdracht van klimaattechnologie. Bij het onderzoek is eerst uitgegaan van historisch institutionalisme om oorzaken van het gebrek aan ambitieuze internationale overeenkomsten op het gebied van overdracht van klimaattechnologie in kaart te brengen. Daarnaast is gebruikgemaakt van de internationale-regimetheorie, met name van de drie kernconcepten daarvan - macht, belang en kennis - teneinde de basisproblemen bij mondiale klimaatonderhandelingen te verklaren en de asymmetrie van belangen en behoeften van partijen wat betreft de overdracht van klimaattechnologie in het kader van het UNFCCC te beoordelen. Ook is uit relevante inzichten van ontwikkelingstheoretici geput om te beoordelen of en hoe de ontwikkelingsbenaderingen van landen de overdracht van klimaattechnologieën versnellen. Om de doelmatigheid van de technologieoverdracht op bedrijfsniveau te beoordelen, is verder gebruikgemaakt van de "Actor-Network Theory" (ANT) en de theorie van absorptiecapaciteit (TAC). Aan de hand van een combinatie van deze twee gezichtspunten kunnen problemen met betrekking tot informatietoegang en -assimilatie worden blootgelegd.

In het eerste onderdeel (hoofdstuk 4) van de onderzoekshoofdstukken (hoofdstukken 4 t/m 6) worden de redenen voor de moeilijkheden bij het opzetten van concreet internationaal beleid inzake de overdracht van klimaattechnologie onderzocht. Er wordt ingegaan op de herkomst en

structuur van de onverenigbare voorkeuren en overeenkomsten van landen in het kader van het UNFCCC. Het hoofdstuk biedt tevens inzichten voor het onderzoeken van de redenen achter overeenkomsten en verschillen die zouden kunnen bestaan tussen het internationale debat over de overdracht van klimaattechnologie in het kader van het UNFCCC, nationale beleidsmaatregelen en prioriteiten voor klimaatvriendelijke instellingen (zoals besproken in hoofdstuk 5), en de effectiviteit van technologieoverdracht op bedrijfsniveau (zoals besproken in hoofdstuk 6). Hoofdstuk 4 gaat specifiek in op de inhoud en de processen die aan de orde zijn geweest tijdens de onderhandelingen gedurende de klimaatconferentie in Kopenhagen in 2009. Tevens worden de beleidsstandpunten van landen over internationale ecologisch verantwoorde technologieoverdracht als mechanisme voor inperking van en aanpassing aan de klimaatsverandering tegen het licht gehouden. Beoordeeld wordt wat de uitkomsten kunnen betekenen voor de bevordering van internationale overdracht van klimaattechnologie. Ook wordt gekeken naar de oorzaken van het gebrek aan ambitieuze internationale overeenkomsten op het gebied van overdracht van klimaattechnologie. Dit deel van het onderzoek laat zien dat zodra een grote hoeveelheid landen tot een bepaalde overeenkomst is gekomen, het moeilijk is van dit pad af te wijken vanwege de inflexibiliteit die inherent is aan het voorafgaande proces om een internationaal institutionele overeenkomst te bereiken. Hoofdstuk 4 wordt afgesloten met de conclusie dat oorzaken van de grote verdeeldheid tussen de noordelijke en zuidelijke landen van de wereld en de redenen waarom onverenigbare voorkeuren blijven bestaan, niet gelegen zijn in de afwezigheid van gedeelde normen (bv. het belang van de strijd tegen de klimaatverandering), maar eerder in de omstandigheden die voortkomen uit het beginsel van 'gedifferentieerde verantwoordelijkheden'. Dit kwam voor het eerst aan het licht bij de Byrd-Hagel-resolutie, waardoor het Kyotoprotocol feitelijk werd verlamd. Het beginsel van gedifferentieerde verantwoordelijkheden, dat dateert van de oprichting van het UNFCCC, bleek een groot knelpunt tijdens de conferentie in Kopenhagen en in daaropvolgende bijeenkomsten dat de concrete vooruitgang in de internationale onderhandelingen over het klimaatbeleid belemmerde. Het historisch institutionalisme dat besloten ligt in het beginsel van 'gedifferentieerde verantwoordelijkheden' van het internationale klimaatbeleid in het kader van het UNFCCC, heeft geleid tot de zeer simplistische onderverdeling van technologieoverdracht in noord en zuid. De resultaten in hoofdstuk 5 komen echter niet overeen met de traditionele karakterisering van overdracht van ontwikkelde landen naar ontwikkelingslanden en van noord naar zuid als de voornaamste vorm van technologieoverdracht.

De onderzoeksbevindingen in de hoofdstukken 4 en 5 duiden er op dat de harmonisatie van het nationale en het internationale niveau zich met name op twee aspecten toespitst: Ten eerste vinden de inspiratie opgedaan door en de invloed van de alliantie G77+China voor internationaal klimaatbeleid in het kader van het UNFCCC hun weerslag in het overdrachtsproces van klimaattechnologie op het nationale niveau van een ontwikkelingsland. Het tweede aspect is het feit dat de regeringen van ontwikkelingslanden hebben getracht en nog steeds trachten hun nationaal beleid vorm te geven of te hervormen naar de behoeften van het mondiale klimaatbeleid in het kader van het UNFCCC, ook al gaan deze wijzigingen in nationaal beleid nog niet ver genoeg.

In de nationale component van het proefschrift (hoofdstuk 5) wordt de rol van ontwikkelingslanden als ontwikkelaar en ontvanger van internationale technologische innovaties benadrukt. Ondanks het feit dat de economische vooruitgang en de technologische verfijning in specifieke ontwikkelingslanden algemeen worden erkend, hebben deze wijzigingen afgezet tegen de internationale technologiestroom relatief weinig aandacht gekregen binnen het wetenschappelijk onderzoek en zijn er geen coherente internationale beleidsmaatregelen in het kader van het UNFCCC. Hoofdstuk 5 van het proefschrift gaat dieper in op het potentieel, de kenmerken en de relevantie van zuid-zuid-samenwerking als het nieuwe technologie-overdrachtsparadigma voor internationale, ecologisch verantwoorde technologieoverdracht. Daarbij wordt de rol van ontwikkelingslanden als ontwikkelaar en als ontvanger van technologische innovaties benadrukt. De bewijsmiddelen voor dit deel van het proefschrift inzake zuid-zuid-overdracht van klimaattechnologie zijn afkomstig van een analyse van de situatie in Ethiopië. Het bewijsmateriaal wijst erop dat de technologische samenwerking van de minst ontwikkelde landen, zoals Ethiopië, met ontwikkelde landen aan het afnemen is. Samenwerking met het zuidelijk halfrond komt hiervoor in de plaats.

In het onderzoek wordt echter geconcludeerd dat de zuid-zuid-overdracht geen alternatief is voor de overdracht vanuit het noorden. Het is slechts een belangrijke aanvulling hierop, met als doel de stroom van technologie naar ontwikkelingslanden te bevorderen. Het onderzoek heeft geen aanwijzingen uit de beleidspraktijk opgeleverd dat behoud van natuurlijke hulpbronnen een motivatie vormt voor deze zuid-zuid-overdracht van klimaattechnologie. Politieke solidariteit in internationale klimaatregelingen tussen de landen op het zuidelijk halfrond vormt evenmin een grote motivatie voor de zuid-zuid-overdracht van klimaattechnologie. Uit het hoofdstuk blijkt dat

er binnen de zuid-zuid-overdracht van klimaattechnologie ook een gebrek aan steun is voor verbetering van de institutionele infrastructuur van het land waaraan de overdracht plaatsvindt. Tevens heeft de opkomst van het staatskapitalisme de betrokkenheid van de private sector als motor van innovatie beperkt. Bovendien wordt de zuid-zuid-overdracht van klimaattechnologie gekenmerkt door beperkte interactie van lokale bedrijven binnen de toeleveringsketen en beperkingen bij het veranderen van de oneerlijke noord-zuid-handelsbetrekkingen. Deze beperkingen leggen de behoefte bloot aan adequate en effectieve beleidsmaatregelen om de netto voordelen van ontvangende landen te optimaliseren en te zorgen voor een win-winsituatie bij technologische samenwerking. De overdracht van klimaattechnologie van de landen van het noordelijk halfrond naar die van het zuidelijk halfrond, zoals besproken in hoofdstuk 4, is kenmerkend voor het klimaatbeleid op internationaal niveau in het kader van het UNFCCC. Dit komt niet overeen met nationale beleidsmaatregelen en strategieën, die meer geneigd zijn tot zuid-zuid-overdracht. In beleidsdocumenten van ontwikkelingslanden, zoals beschreven in hoofdstuk 5, heeft zuid-zuid-overdracht de voorkeur, en niet noord-zuid-overdracht. Zuid-zuid-overdracht wordt gekarakteriseerd als een technologische samenwerking gebaseerd op inachtneming van nationale soevereiniteit, nationale ownership en onafhankelijkheid, gelijkheid, niet-voorwaardelijkheid, het uitblijven van bemoeienis, en wederzijds profijt. Deze karakterisering, die behalve in de beleidsdocumenten ook terug te vinden is in de opvattingen van politici in ontwikkelingslanden, komt overeen met de solidariteitsgeest van de G77+China in internationale klimaatonderhandelingen. Op dit punt kan een raakvlak tussen de strategieën op nationaal niveau en het internationale beleid inzake klimaatregelingen worden geobserveerd. De alliantie G77+China is voortgekomen uit het historisch institutionalisme dat besloten ligt in het beginsel van 'gedifferentieerde verantwoordelijkheden'. In hoofdstuk 6 van het proefschrift wordt aandacht besteed aan de uitvoering van nationale beleidsmaatregelen op lokaal niveau in de context van internationale onderhandelingen. Het hoofdstuk behandelt de beperkingen van de bestaande vakliteratuur om aan de hand van empirisch bewijs van kleinschaligere eenheden nadere gegevens te verstrekken over de overdracht van klimaattechnologie in ruimere zin. Tevens wordt aandacht besteed aan de beperkingen van studies waarbij alleen gekeken wordt naar het gezichtspunt van actoren die betrokken zijn bij de feitelijke overdrachtsactiviteiten ten aanzien van klimaattechnologie. Als voortzetting van het onderzoek op nationaal niveau (hoofdstuk 5) bevat de studie op bedrijfsniveau ook een analyse van Ethiopië als gastland voor technologieoverdracht met andere ontwikkelingslanden en ontwikkelde landen als ontwikkelaar van technologieoverdracht. In Ethiopië zijn drie projecten geselecteerd als casestudy met de

bedoeling om de overdracht van klimaattechnologie als opkomend verschijnsel te bestuderen en om de doelmatigheid van de technologische samenwerkingsmodaliteiten ter bevordering daarvan te beoordelen.

In het proefschrift wordt de doelmatigheid onderzocht van noord-zuid-overdracht, zuid-zuid-overdracht en noord-zuid-zuid-overdracht van klimaattechnologie, gezien door de bril van het vermogen van een bedrijf om toegang te krijgen tot informatie en om de uit externe bronnen verkregen kennis ook daadwerkelijk te gebruiken. Deze drie samenwerkingsmodaliteiten worden vergeleken, en de effectiviteit ervan voor het verbeteren van de technologieoverdracht op bedrijfsniveau gepeild. De doelmatigheid van de overdracht van klimaattechnologie op bedrijfsniveau wordt beoordeeld door te kijken naar de afzonderlijke en gecombineerde effecten die het bedrijfsnetwerk en de absorptiecapaciteit hebben op de overdracht van klimaattechnologie.

Voor deze component van het onderzoek luidt de onderzoeksvraag als volgt: hoe effectief zijn de internationale samenwerkingsmodaliteiten (noord-zuid, zuid-zuid en noord-zuid-zuid) voor het verbeteren van de overdracht van klimaattechnologie op bedrijfsniveau?

De drie samenwerkingsvormen (noord-zuid, zuid-zuid en noord-zuid-zuid) hebben elk hun specifieke kenmerken en resulteren in een ongelijke mate van effectiviteit van de technologieoverdracht. In alle drie de samenwerkingsvormen is sprake van technologische capaciteit, maar de mate waarin verschilt sterk. De resultaten wijzen op de complementaire aard van noord-zuid- en zuid-zuid-overdracht, en bevestigen dat noord-zuid-zuid-overdracht een belangrijke manier is om de effectiviteit van deze complementariteit te vergroten en om de technologieoverdracht te bevorderen omdat hierin de relatieve voordelen van noord-zuid- en zuid-zuid-overdracht worden verenigd. De resultaten van het onderzoek op nationaal niveau (hoofdstuk 5) en dat op bedrijfsniveau (hoofdstuk 6) laten zien dat er punten van overeenstemming bestaan tussen nationale strategieën en lokale praktijken voor overdracht van klimaattechnologie. Deze kunnen worden verklaard door het feit dat regeringen van de minst ontwikkelde landen, zoals Ethiopië, een vraag naar klimaattechnologie op bedrijfsniveau hebben gecreëerd door middel van hun nationale beleidsmaatregelen en strategieën. Bovendien neigt nationaal beleid naar staatskapitalisme (de 'ontwikkelingsstaat'), zoals wordt weerspiegeld in de focus die regeringen van ontwikkelingslanden zoals Ethiopië hebben om bedrijven in staatsbezit op te richten dan wel te versterken. Bijgevolg wordt de technologische samenwerking in de zin van zuid-zuid-overdracht op bedrijfsniveau gedomineerd door bedrijven in staatsbezit (bv.

samenwerking tussen een Ethiopisch bedrijf in staatsbezit en een bedrijf in staatsbezit in een ander ontwikkelingsland, met name China). De afstemming tussen het klimaatbeleid op nationaal niveau en de overdrachtspraktijken ten aanzien van klimaattechnologie op bedrijfsniveau wordt echter door bepaalde factoren gehinderd. In tegenstelling tot de ambities van nationale regeringen om de lokale bedrijfs capaciteit door middel van internationale technologische samenwerking op basis van zuid-zuid-overdracht te vergroten, blijkt uit dit onderzoek bijvoorbeeld dat er binnen de zuid-zuid-overdracht slechts beperkte verbanden zijn tussen mondiale ondernemingen en lokale bedrijven en dat dit gebrek aan betrekkingen de doelmatigheid van de overdracht van klimaattechnologie negatief beïnvloedt. Hierdoor wordt de technologieoverdracht vanuit het zuidelijk halfrond minder effectief vergeleken met de technologiestromen binnen de noord-zuid- en noord-zuid-zuid-overdracht.

Aan de andere kant van de meerlagige besluitvormingsstructuren kan gezegd worden dat het feit dat het internationale klimaatregime vooral gericht is op noord-zuid-overdracht (hoofdstuk 4) en de geringe aandacht voor zuid-zuid-overdracht in strijd zijn met de resultaten van de studie op bedrijfsniveau (hoofdstuk 6). Hieruit blijkt namelijk de complementaire aard van noord-zuid-overdracht en zuid-zuid-overdracht op bedrijfsniveau. Tevens geeft het onderzoek op bedrijfsniveau de relatief grotere effectiviteit aan van noord-zuid-zuid-overdracht.

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ERRATUM

Figure 6.6 Messebo project network analysis (based on Law and Callon 1992)
(page 149)

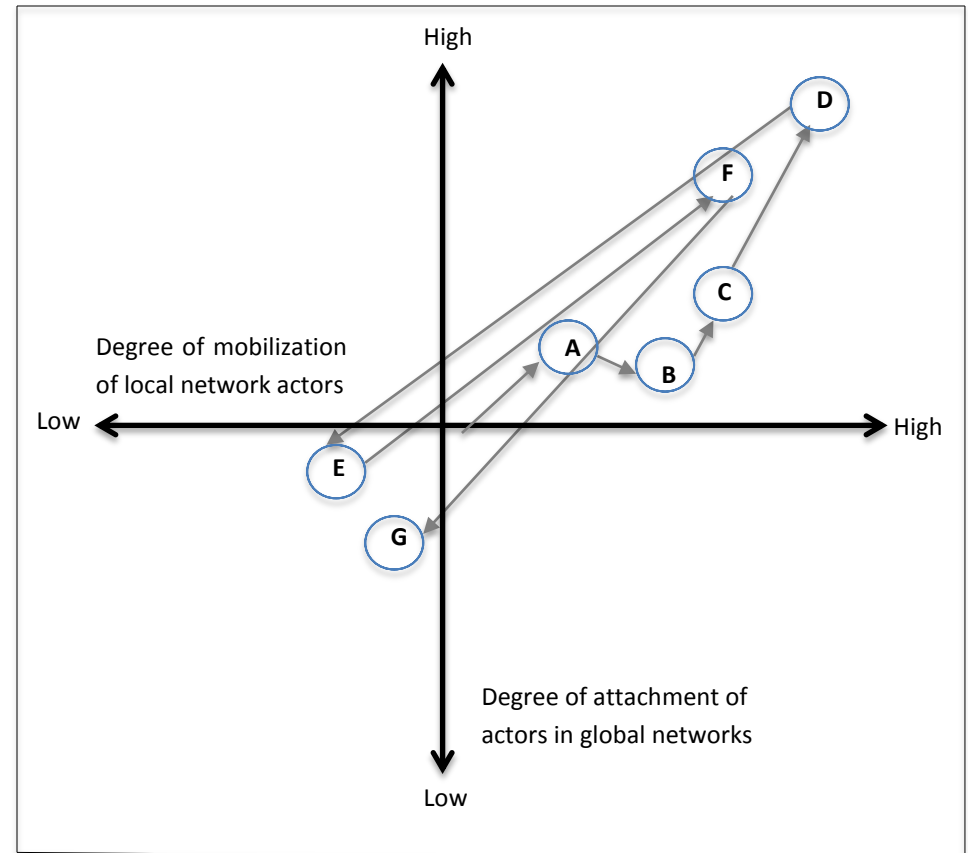


Figure 6.7 Ashegoda Project network analysis (based on Law and Callon 1992) (page 151)

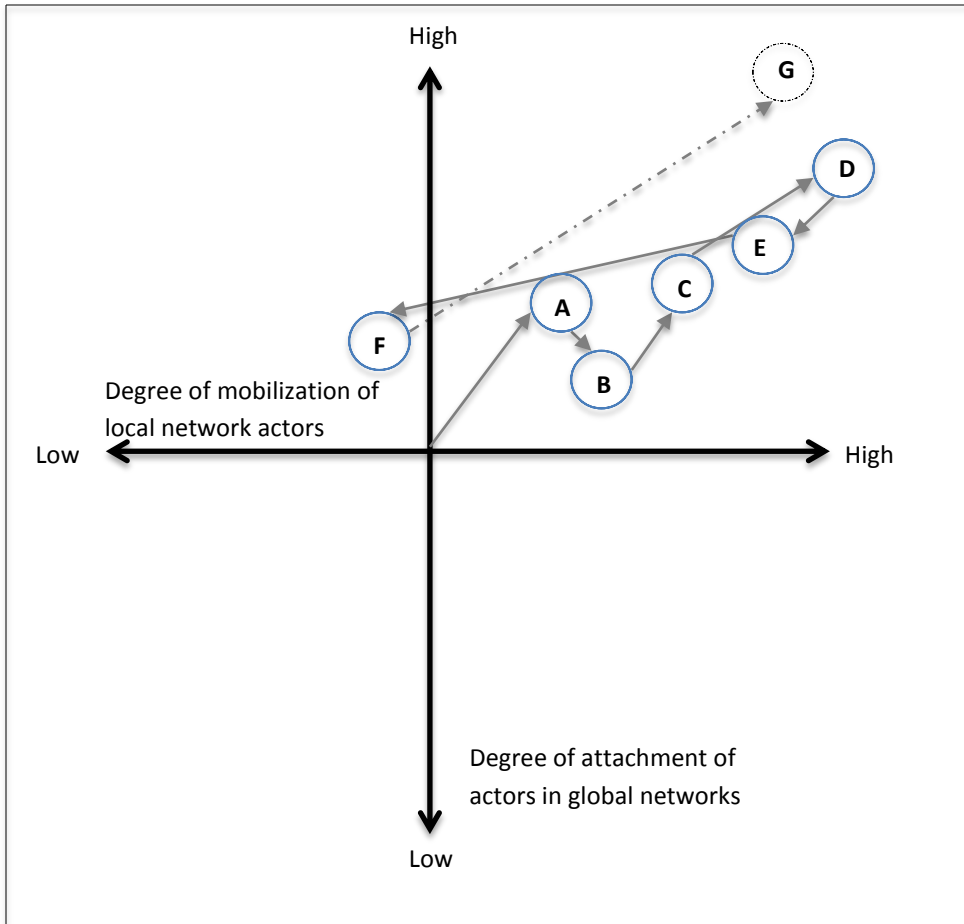


Figure 6.8 Nazreth Project network analysis (based on Law and Callon 1992) (page 152)

