# "The cream on the pudding...."

*An analysis of the Clean Development Mechanism in the Indian wind power sector*

**Zlata Turkanovic**

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*Centre for Development and the Environment*

*University of Oslo*

*Blindern, Norway*

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# Abbreviations and glossary

| | |
|---|---|
| **Abatement/mitigation** | Prevention of greenhouse gas emissions from a source in to the atmosphere |
| **Additionality** | Requirement that GHG emissions after implementation of a CDM project activity are lower than those that would have occurred in a business-as-usual scenario |
| **Annex I countries** | Industrialized countries that must reduce their emissions of GHGs under the Kyoto Protocol |
| **Business-as-usual** | Also known as baseline scenario; hypothetical reference case representing the volume of GHG that would have been emitted if the project were not implemented. |
| **CDM** | The Clean Development Mechanism |
| **CDM Pipeline** | Official database containing all CDM projects |
| **CER** | Certified emission reduction units |
| **$CO_{2e}$** | Carbon dioxide equivalents; term used to equate six different GHGs to $CO_2$ in the Kyoto Protocol |
| **DNA** | Designated National Authority |
| **DOE** | Designated Operational Entity |
| **EB** | Executive Board; main supervisory body of the CDM |
| **GHG** | Greenhouse gas |
| **InWEA** | Indian Wind Energy Association |
| **IREDA** | Indian Renewable Energy Development Agency |

| | |
|---|---|
| **Jaisalmer** | City in south Rajasthan bordering on the Thar desert, experienced large wind power developments during the last seven years |
| **Kyoto Protocol** | Global agreement signed and ratified by 180 countries aimed at stabilization of GHGs in the atmosphere. The commitment period is from 2008 to 2012. |
| **MNRE** | Ministry of New and Renewable Energy |
| **Non-Annex countries** | Developing countries who are parties to the Kyoto Protocol, but do not have commitments to reduce emissions of GHGs |
| **Offsets** | Carbon offsets represent the reduction of one metric ton of $CO_2$e through financial support of CDM projects that reduce the emission of GHGs in developing countries |
| **PDD** | Project design document |
| **PP** | Project proponent |
| **Rajasthan** | State in the Northwest region of India |
| **RERC** | Rajasthan Electricity Regulatory Commission |
| **RREC** | Rajasthan Renewable Energy Corporation |
| **Rupee** | Indian currency. 1 rupee = 0, 02 $ US |
| **UNFCCC** | United Countries Framework Convention on Climate Change |
| **WEG** | Wind Energy Generator |
| **Wind power tariff** | The price a wind energy producer gets for selling its power to the state power companies. Usually much higher than the price for selling power generated from coal. |

# 1. Introduction

In 1997, fear of the adverse effects of climate change led the global community to agree on the Kyoto Protocol, where the inclusion of the Clean Development Mechanism (CDM) was a surprise (Grubb et al. 1999) [1]. Under the agreement, developed countries (known as Annex I countries) can utilize the CDM to offset their greenhouse gas (GHG) emissions by investing in projects that contribute to overall reduction of GHG emissions and sustainable development in developing countries (non-Annex I). The mechanism is designed to achieve this twin objective through use of market-based actions such as investment and technology transfer. The CDM is based on the idea that these actions will bring about a win-win solution for all involved parties.

India emerged as an attractive host country for CDM projects due to a growing economy fueled by coal. It is the world's fifth-largest GHG emitter and the second-largest CDM host country. The majority of GHGs are emitted by the energy sector, where coal stands for 55 percent of electricity generation (Pew Center 2008). Renewable energy is considered a viable option in order for the Indian government to provide electricity for its impoverished population and support industrialization. Wind power is most prominent, and has also captured the largest share of CDM projects.

## 1.1 Thesis aims and research questions

This thesis explores the effects of the CDM on the Indian wind power industry through fieldwork in an especially dense wind power area in the Indian state of Rajasthan. The overall aim of the project is:

[1] The United States and Australia opted out of the agreement on the grounds that it would harm their economy since the major developing countries were not given binding emission targets.

*What effect has the Clean Development Mechanism had on the development of wind power in India?*

India is under no obligation under the Kyoto Protocol to reduce its GHG emissions according to specified targets. Instead, the country is supposed to benefit from developed countries' obligations by participating in a global climate agreement through the CDM. The gains from implementation of CDM projects were expected to be, among other things, increased foreign investments, technology transfer, infrastructure development, reduced dependency on fossil fuels, increased employment and increased energy generation (UNFCCC 2009, Ellis et al. 2007).

To provide insights on the realization of benefits for the largest share of Indian CDM projects, this thesis focuses on three aspects of their deployment: the transfer of wind power technology; policymaking to expand and develop the wind power sector; and implications for the local area where projects are implemented. Thus, three subsidiary aims are formulated as:

- *Has the CDM made an added contribution to India's national policies for the development of the wind power sector?*
- *Has the CDM contributed to technology transfer and diffusion to the wind power industry in India and the state of Rajasthan?*
- *What has been the contribution of CDM wind power sites to the city of Jaisalmer in the state of Rajasthan?*

The CDM is analyzed through applications of two approaches to policymaking (Langhelle 2000), ecological modernization and sustainable development. The former focuses on social, institutional and political change as a response to environmental problems created by industrialized countries (Mol and Sonnenfeld 2000, Mol 2001). Sustainable development grew out of an attempt to integrate environmental and developmental policies in order to address the growing disparities between North and South (Langhelle 1999). Although both approaches account for environmental issues in policymaking, the main difference lies in ecological modernization's neglect of social justice (Langhelle 2000). This thesis claims that the CDM can be seen as an attempt to fuse sustainable development and ecological modernization in an instrument with global ramifications. Whether or not this fusion has been a success for all involved is explored through interviews with informants handling several CDM wind power projects outside of Jaisalmer in Rajasthan, villagers affected by those CDM projects, state government officials, a national ministry official and industry representatives.

The majority of CDM studies (Haake 2006, de Coninck et al. 2007, Seres et al. 2007, Dechezleprêtre et al. 2008, Voigt 2008, Wara 2008) have been based on project design documents and attempted to quantitatively analyze the implications of the CDM. This thesis aims to present a different view on the same issues: one grounded in a qualitative analysis of stakeholders directly involved with the CDM.

## 1.2 Structure of the thesis

The thesis is divided into three parts where chapters 1 through 3 give an introduction and methodology. Section 1.3 begins with a short overview of the Kyoto Protocol, CDM system, and the CDM market. Chapter 2 explains the methodology and the case study in Jaisalmer, Rajasthan. In chapters 3 through 5 the theoretical framework of this thesis is presented. Throughout these chapters, ecological modernization, sustainable development and technology transfer are discussed in their relation to the Kyoto Protocol. Finally, chapters 6 to 8 provide the empirical findings from fieldwork conducted in New Delhi and Jaisalmer. These chapters are divided according to the above-mentioned subsidiary aims. Chapter 9 provides a summary and conclusion to this thesis.

## 1.3 The Clean Development Mechanism

The Kyoto Protocol, which was finalized in 1997, is a global agreement ratified by 190 developed and developing countries. The Protocol came into effect in 2005 and mandates Annex I countries to reduce their emissions of GHGs to specified levels. These levels are set at five percent below the collective emission levels of Annex I countries in 1990 (UNFCCC 1998). At the time of agreement, this goal was thought of as sufficient enough to stabilize GHG concentrations in the atmosphere. The target was to be achieved within the first commitment period of the Protocol, from 2008 and until 2012.

Negotiations for the Protocol started after the United Countries Framework Convention on Climate Change (UNFCCC) was adopted in 1992, when the Parties saw that the Convention was too weak to attain its goal of stabilizing GHGs at a level that would not threaten the planet. The Protocol is an update of the UNFCCC, but unlike the UNFCCC it sets clear and differentiated targets for all the industrialized countries. It also lays the groundwork for mechanisms that can achieve those targets (Depledge 2004, UNFCCC 1998).

One of the main principles of the UNFCCC and the Protocol is the notion of "common but differentiated responsibilities." It accounts for equity considerations among nations with the result that developing countries such as India do not have to curb their emission of GHGs. Instead, they are expected to benefit from developed countries' efforts of mitigating their emissions. Annex I countries can use the flexible mechanisms such as CDM, joint implementation (JI) or emissions trading to offset their emissions and thus achieve their emission targets. This is done by financing projects which contribute to technology transfer and related foreign investment (UNFCCC 2009).

Although technology transfer and foreign investment are not an explicit goal of the CDM, one of the objectives of the CDM is to "(…) assist Parties not included in Annex I [developing countries] in achieving sustainable development… (UNFCCC 1998: 11)." With the inclusion of sustainable development as one of the main objectives of the CDM, there was a hope that it could function as an international transfer mechanism for new and climate-friendly technology (Seres et al. 2007, Dechlezlepretêtre et al 2008). The Protocol itself urges Annex I countries to transfer environmentally sound technologies (ESTs) [2] under Article 10c. The transfer of ESTs to developing countries is a way for them to avoid a path of development which includes massive GHG emissions. Since developing countries do not have to reduce their emissions under the Protocol, the CDM provides a way of participating in the agreement.

Article 12 of the Kyoto Protocol defines the dual purpose the CDM, the other objective being "…to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments…(UNFCCC 1998: 11)." This means that in addition to and instead of curbing emissions at home to comply with their Kyoto targets, developed countries can invest in projects in developing countries and thereby get emission reduction units applied to those assigned targets. CDM emission reduction units are called Certified Emission Reductions (CERs) and represent one tonne of carbon equivalents. CERs function as offsets of carbon emissions in Annex I countries because the reduction of GHG emissions within the global climate system does not depend on geography. With the issuance of CERs the CDM was turned into a market-based system for trading emissions permits. The intention behind creating a market-based system was that revenue from CERs would fund the cost of reducing GHG emissions, and also include participation of the developing countries in an international climate regime (Wara 2008).

The design of the CDM and its market-based approach to GHG mitigation is based on the idea that reducing emissions in Annex I countries has a higher marginal cost than in developing countries, especially rapidly developing

[2] Environmentally sound technologies are defined by the IPCC as: technologies 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 technologies for which they are substitutes for. EST should also be compatible with nationally determined socio-economic, cultural and environmental priorities. The term includes both hard and soft technologies (IPCC 2000).

countries such as India and China. Building more efficient, lower GHG-emitting industrial and energy facilities in the developing world is cheaper than prematurely shutting down or retrofitting the same facilities in Annex I countries. By putting a price on GHG emissions through CERs generated in the developing world, and by linking that price with emissions trading markets in the developed world, Annex I countries can save on abatement costs and spur investment in developing countries. This was one of the main reasons for creating the CDM (ibid, Dechezleprêtre et al. 2008, Voigt 2008). When describing the formation of an international carbon market from the EU's point of view, Grubb et al. (1999:97) state: "Indeed, the promise of international money flows form the glue behind the political consensus underpinning Kyoto."

## 1.4 Proving additionality

The involvement in the CDM is not restricted to governments of Annex I countries. Private sector actors, from both developed and developing countries, can invest in CDM projects and trade emission credits. To establish a CDM project, the developers must prove that the project would have not happened without the CDM and the expected revenue from CERs. There has to be some technological, financial, legal or institutional reason for why the project has no chance of starting up. This is known as additionality (CDM Rulebook 2008a). Without additionality, the project is deemed as "business-as-usual" and will be rejected. Additionality was introduced to ensure the integrity of the Kyoto Protocol and is a necessary requirement for the CDM to function as a mechanism which compensates for emissions that are not been reduced domestically. If CERs are created for projects that would have happened *anyway*, then these "fake" CERs will undermine the whole mechanism and increase the overall concentration of GHGs in the atmosphere (Voigt 2008)[3].

[3] Then emissions in developed countries would not be offset by real reductions in developing countries

The issue of additionality is further complicated by the fact that it is applied differently between countries and regions (Depledge 2004). If a country routinely encourages use of biomass due to natural abundance and has policies to insure sustainable use, then this activity is deemed non-additional. In the case of India, where there have been strong polices to promote installation of wind power projects, one might imagine that Indian wind power will fall outside of the CDM system because it can be seen as "business-as-usual". In 2001, signatories of the Kyoto Protocol met in Marrakech and agreed upon the rules for meeting their emission targets in the Marrakech Accords. These give the project developers plenty of leeway to prove additionality (ibid.): for example, Indian wind power projects refer to “financial additionality” as a main obstacle to setting up wind power. They claim that they must get the CER money or the project will not be viable at all. Viapradas, an informant in Senergy Global a consulting firm for CDM, explained that Indian wind power projects have had a difficulty proving additionality because of the financial incentives given by the government. His view was that “wind was going out of CDM”, meaning that it soon will be deemed non-additional. One of the main issues was that new legislation, the Electricity Act 2003, which forced states to provide preferential tariffs for renewable energy and set provision targets for renewable energy generation, clashed with the additionality criteria in the CDM. I will come back to this issue in later chapters.

## 1.5 The CDM-system

The CDM is a system that operates both on a national and a global level, as can be seen in figure 1. The figure depicts the process (referred to as CDM project-cycle) that must be followed by those who wish to utilize the CDM. It also explains the rule of the *main participants* and their *abbreviations*. Climate change is a global issue where all countries contribute to the problem and all countries will be affected by it, albeit differently. The CDM is a multi-stakeholder governance agreement designed to provide transparent and accountable forms of "(...) environmental action at the global level" (Lövbrand et al. 2009:77).

The design of the system is based on legitimacy, in this case input legitimacy. Input legitimacy comprises of three procedural qualities: transparency, accountability and participation. The first step in the project cycle should ensure transparency. Transparency refers to the openness of the decision-making process where those who participate have to have adequate information about the entire process in order to take a stance (ibid.). Anyone attempting to participate in the CDM system must first submit a Project Design Document (PDD) and a Project Concept Note (PCN) to the DNA. The PDD is the most important document in the system; it is the blueprint for getting a project approved under the CDM. It contains a thorough description of the project and its economic, technological, social and environmental effects with regard to GHG emissions. Currently, CDM projects fall into eight categories[4], each of which contains several types of projects. Wind power falls into the renewable energy category. The PDD goes through the cycle in figure 1. In the CDM cycle it is the PDD which gives information to all involved parties and anyone else who wishes to participate. Each PDD and its history throughout the cycle are made available for the public through the UNFCCC website.

[4] These are: renewable energy, energy efficiency improvement, projects activities which reduce energy consumption, on the supply and/or demand side, agricultural projects, fuel switching, industrial processes and waste management (CDM Rulebook [Eligible projects] 2008. Retrieved 21.03.2009)

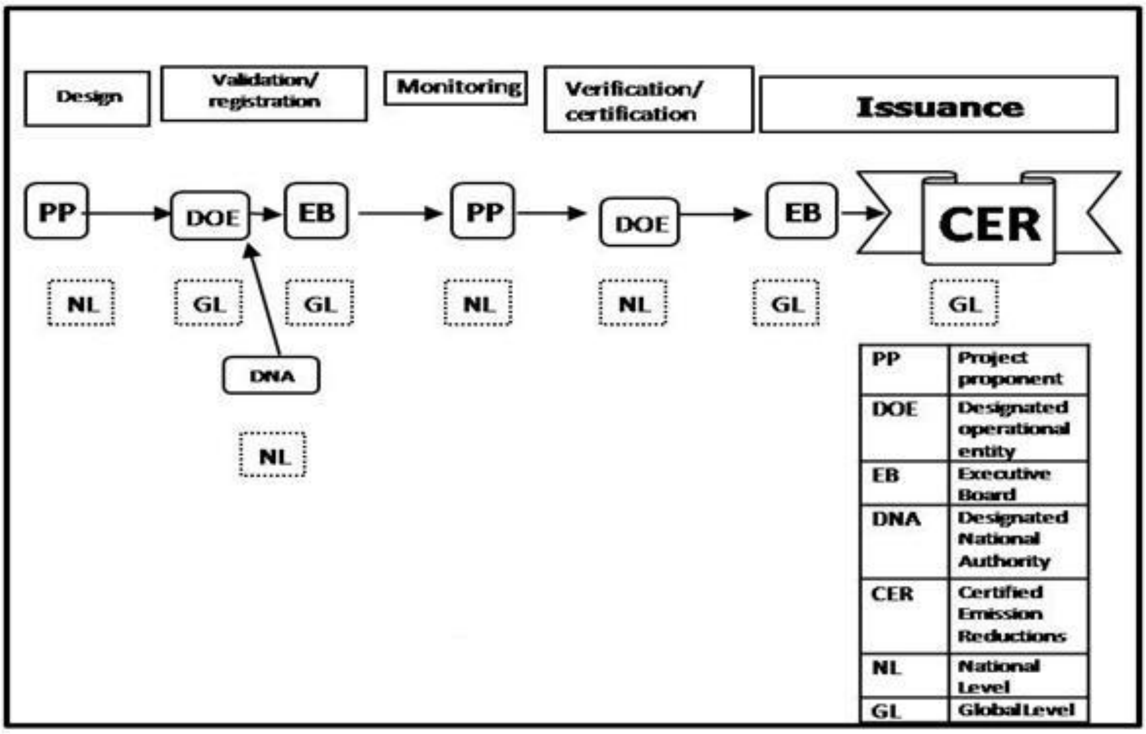


Figure 1. The CDM Project Cycle

The DNAs are the main CDM authorities in their own countries and they are the first tier of validation for a given project. The DNAs assess whether or not a project meets the sustainable development objectives and if the project stands a chance of being successfully implemented as CDM (CDM Rulebook 2008b).

For a PDD to advance in the cycle, the project must gain approval on the national level. This is done by the DNA in “the host country letter of approval” (ibid.). In order to prove reduction additionality a PDD must include a *baseline scenario* that represents the volume of projected GHG emissions in the absence of the project, and a *project scenario*– a forecast of emissions reductions if the project is approved. The difference in emissions between the two scenarios is what the PPs can claim as emissions reductions, and eventually earn CERs for. The baseline scenario is a methodology developed and approved by the CDM EB, and it includes the PPs’ calculations of how much GHG emissions their project will “save” (CDM Rulebook 2008c).

In order to prevent PPs from cheating on their calculations, and thus get more CERs than they should, the EB has approved several companies to act as DOEs.

The PP can pick a DOE of his choice. As depicted in Figure 1, they are involved in the CDM project cycle twice: first as validators, confirming that the project fits the CDM criteria, then as verifiers and certifiers of the actual reductions of GHG (CDM Rulebook 2008d). The DOEs operate at an intersection of the global and national levels, as they must apply global CDM rules in a national setting while validating a project. Since all of the approved DOE companies are transnational corporations such as the auditing firm Deloitte, Det Norske Veritas Certification[5] (DNV) etc, I have categorized the DOEs as operating on a global level in figure 1. In the first part of the cycle the DOE has to verify that the proposed project meets the current CDM criteria, consult with stakeholders, publicize the PDD via the CDM website and open the PDD for comments (ibid).

The DOE is also to verify that the PP has consulted with local stakeholders such as individuals, groups or communities affected by the CDM project (CDM Rulebook 2008e). This type of participation is a way of giving input legitimacy to the whole process and fosters the inclusion of affected stakeholders. The DOE's responsibility lies in determining if the project's developers have fulfilled their duties. The work of the DOE is one part of ensuring accountability in the CDM project cycle (Lövbrand et al. 2009). The DOE is ultimately accountable to the EB. On the national level, participation takes the form of stakeholder meetings for people affected by CDM projects. In Jaisalmer, I interviewed an engineer working for the wind power manufacturer Suzlon who was responsible for organizing stakeholder meetings. He would announce a stakeholder meeting in local newspapers, and depending on how many had read the notification, he would hold a presentation of the projects and introduce the project's investors to. The villagers also had the chance to voice their concerns and wants during these meetings.

After a project undergoes *validation* by the DOE, the DOE then sends a request for registration to the EB. The EB was established as a supervisor of the CDM in

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[5] A full list of the DOEs is available at: http://cdm.unfccc.int/DOE/list/index.html

article 12.4 of the Protocol, and includes ten representatives elected from the parties to the Protocol. Besides being the ultimate tier in the CDM cycle, they also approve new methodologies, make recommendations to the Conference of Parties (the supreme body of the UNFCCC, i.e. all signatories of the Convention), and maintain a registry of CDM projects and a database of rules, procedures and methodologies (CDM Rulebook 2008f).

From the point of view of the PPs, the EB is the last hurdle before they can receive CERs. When the validated PDDs reach the EB, they are first appraised by a Registration and Issuance Team. On their advice the EB votes on whether the project is to be *registered.* This is the point where the project is formally recognized as a CDM project. The EB is foremost a global actor, as one of their functions is to consider the global effects of single CDM projects.

After that stage, it is up to the PP to *monitor* actual emission reductions achieved by the project, and submit a request for *verification* to the DOE. The DOE conducts an independent review of the monitoring data, and *certifies* that the emission reductions of the registered CDM project are real. In the last leg of the cycle, the certification report is sent to the EB which *issues* the specified number of CERs. These are issued on a global level, and they can be bought by Annex I parties (CDM Rulebook 2008g).

## 1.6 The CDM Market

The CDM has experienced exponential growth since 2005, as can be seen in figure 2. In January 2010 there were 2000 CDM projects that had passed registration, and there were another 2900 projects in the pipeline of the CDM system (UNFCCC Secretariat 2010). The EB anticipates that the mechanism will generate more than 2.9 billion CERs by 2012 (ibid.), while market analysts have estimated that the CDM only will generate approximately 1.1 billion CERs by the end of 2012 (Point Carbon February 2010). The emission offsets represented by the CERs are still quite small compared to what the world’s largest emitters collectively release into the atmosphere every year. In 2006, China and the US emitted approximately 12 billion tonnes of $CO_2$ (UN Statistics Division 2009). Renewable energy projects make up over 60 percent of all projects, but generate only about 35 percent of all CERs (UNEP Risoe CDM Pipeline January 2010). Even though the CDM is not yet a pronounced option for achieving global GHG stabilization, it can be a tool for improving the development of low-carbon energy infrastructure in the developing world.

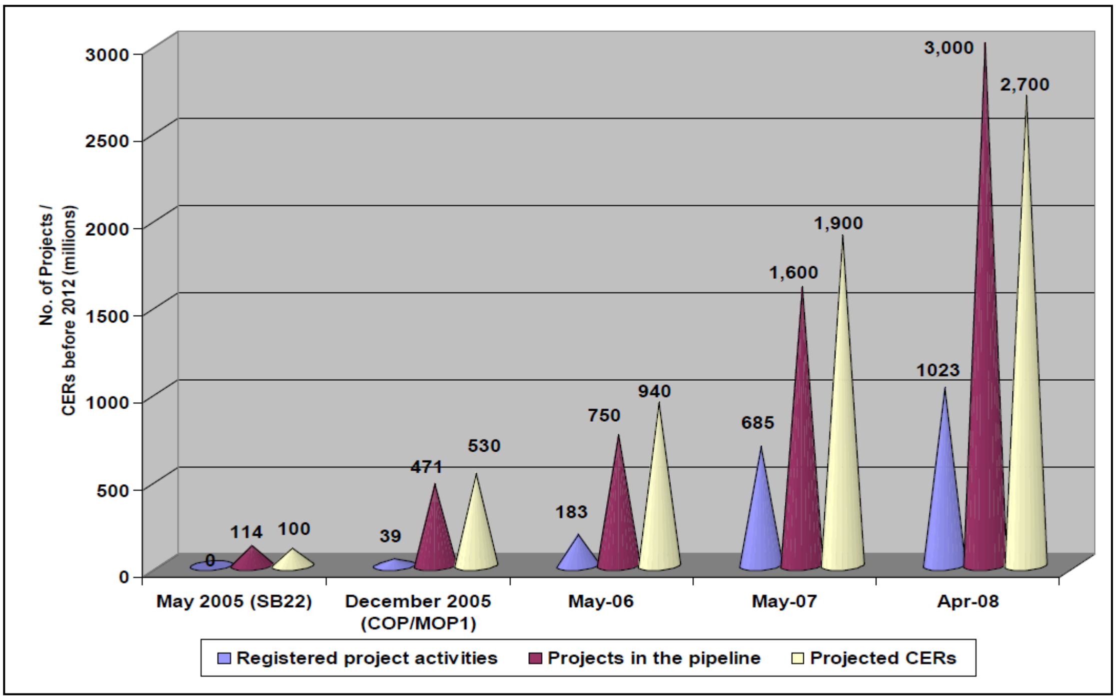


Figure 2. Growth of CDM projects in the pipeline over time

Source: Stiansen 2009 based on UNEP Risoe CDM Pipeline data

From the inception of the CDM, India, along with China, emerged as one of the most attractive countries for CDM investment. In June 2009, China, India, Mexico and Brazil hosted 73 percent of all CDM projects. China has 50 percent share of the CDM in Asia (1726 registered projects); while India has 33 percent (1123 registered projects). Latin America and Asia are hosts for 93 percent of all CDM projects. Africa, Central Asia, Europe (the transition economies) and the Middle East host less than three percent each. Even with a modest estimation of a carbon price of ten dollars per CER, the CDM will direct a little over 2.7 billion dollars to China, India, Brazil and Mexico by 2012[6] (UNEP Risoe CDM Pipeline June 2009).

This was one major concern when the Protocol and especially the CDM principles were chiseled out in Kyoto in 1997. The African countries pointed out that the CDM would accentuate the disparities of the international investment flows among developing countries.

## 1.7 CDM in India

Soon after the Marrakech Accords in 2001, India started establishing a DNA with the help from the German government. Wind power has had a strong presence in India since the creation of the CDM. India currently hosts 351 wind power projects with an installed capacity of 6228 MW (UNEP Risoe CDM Pipeline January 2010). Wind power makes up 28 percent of all Indian CDM projects, while biomass ranks second with 25 percent. Indian wind power projects represent 7 percent of the total CDM pipeline, behind China's 8 percent (ibid.). Unlike China, the Indian DNA has not imposed a tax on specific types of CDM projects. For example, the Chinese use a high tax to discriminate against chemical gas-based projects because they do not contribute to sustainable development. This tax revenue is pooled into a development fund which is supposed to support sustainable development in other ways. The Indians, on the other hand, evaluate how the projects contribute to four sustainable development criteria; social, economic, environmental and technological well-being (Olsen and Fenhann 2008).

[6] This is based on an average annual expected reduction by 2012. It's not certain that the four countries will manage to actually collect all the expected CERs; as I mentioned earlier, the number of expected CERs has been cut down several times.

# 2. Methodology

The CDM has been studied extensively, even before it became fully operational in 2005. Most of the studies have been quantitative and based on PDDs. From the beginning, I wanted to study how CDM projects functioned in their actual surroundings; how the project descriptions in PDDs translate to real life. Having a bachelor's degree in journalism, I wanted to apply the investigative and qualitative attitude to the large and complex system of the CDM. I chose wind power projects in India as a case-study to explore what kind of an effect the CDM has had on the wind power sector. A case study is defined as an "(...) an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin 1994: 13)." They are especially useful when studying contextual conditions, such as the case for this thesis. The CDM is meant to operate in a developing country and contribute to sustainable development and I found it difficult to divorce it from that context. Because there have been many quantitative CDM studies, a qualitative case study of specific CDM projects can complement to this body of research. Specific cases can be important for "(...) the development of a nuanced view of reality ... (Flyvbjerg 2006:203).

## 2.1 The case study area

I chose India because I was there on the study trip in connection with the course SUM 4000 in March of 2008. During a month of lectures and several field trips provided by the Center for Science and the Environment (CSE), we got an in-depth view of India and the environmental and developmental challenges it is facing. The interesting thing is that India has been quite progressive on implementing policies to support renewable energy development, but not as a way to fight climate change. Renewable energy is viewed as a way to fulfill the basic needs of the poor. Fieldwork for this thesis was then conducted in April and May 2009 and lasted for five weeks.

My original interest was technology transfer, and I wanted to focus on large mechanisms through which transfers can take place, such as the CDM. I chose Rajasthan because I had previous knowledge about the state. Also, Rajasthan is considered an up-and-coming wind-power state, so the CDM will have a larger impact here than in a very established wind-power state, such as Tamil Nadu. I chose wind power as the renewable energy carrier because I was aware of the fact that India was one of the world's top wind-power countries, and had implemented national and state policies to develop its market for renewable energies. At the same time, India was at the forefront of registered CDM projects, with wind power capturing most of the CDM investments[7]. I searched for registered CDM projects in Rajasthan via the official UN search tool, the CDM Pipeline[8], in January and February 2009. I soon realized that most of the registered wind power projects are located in the area of Jaisalmer and around the villages of Soda and Akal. I chose three companies which had projects in the CDM cycle: Suzlon, Enercon and RRB Energy.

Jaisalmer is a town located in the middle of the vast Thar Desert in western Rajasthan. With a population of 57,537 (Census of India 2001), Jaisalmer is small relative to major Indian cities, but it is the largest and most important town in the district of the same name. In the last seven years it has experienced an influx of wind-power companies. Jaisalmer District had a total population of just above half a million in 2001, meaning that most of its inhabitants live in smaller towns or villages (ibid.). There are approximately 600 inhabited villages and several of them have windmills in their “backyard”. Due to time constraints and a huge language barrier, I had to limit my research to two villages in the immediate vicinity of the three CDM projects I selected for my study. The Indian DNA mandates that project developers inform and hear from people living in the

[7] As of May 1, 2008, 183 Indian wind power projects were registered as CDM with the CDM Executive Board. They generated 3818 MW of electricity. At that time India had the lead as the country hosting most of the CDM wind power projects, even surpassing China (UNEP Risøe 2008).

[8] The search tool can be found on: http://cdm.unfccc.int/Projects/projsearch.html

vicinity of proposed projects, and that the project contributes to social well-being. The Indian DNA stipulates that:

> "(...) CDM project activity should lead to alleviation of poverty by generating additional employment, removal of social disparities and contribution to provision of basic amenities to people leading to improvement in quality of life of people" (CDM India a).

In 2001, 183 villages in the district of Jaisalmer had access to electricity through the main grid, while 122 villages had domestic access to electricity (Census of India 2001). The state of Rajasthan has an electricity supply gap and has sought to mend the gap by opening up the sector to private investments. Between 2001 and 2007, the state experienced a 26-percent rise in electricity demand, while the peak demand deficit was at 8.4 percent in January 2007 (Malhotra 2007). The state improved, and the following year the deficit decreased to 3.2 percent. But due to weather conditions, namely the monsoon, the peak demand deficit varies during the year. The projected deficit for 2009 was at 9.9 percent due to a projected increase in demand (CEA 2009).

I visited the villages of Soda and Akal[9] on 23 April 2009 with a local interpreter. Soda is located approximately 60 km from the city of Jaisalmer, while Akal is approximately 20 km from Jaisalmer. There are always problems with using an interpreter; they can, intentionally and unintentionally, add different meanings or biases to the translation, which can lead to misunderstandings. But because I have no knowledge of Hindi, and the villagers did not speak English, I had to rely on one. The interpreter was familiar with the villages around Jaisalmer because of his work as a tour guide.

All of the interviews I conducted with various stakeholders during my fieldwork were done in a semi-structured way. Mostly due to time constraints, I chose interviewing rather than observation and participation. Interviewing is a more natural method of data collection to me because of my journalistic background.

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[9] The map can be found in the appendix.

Fontana and Frey (2003:697) write that “(...) interviewing is one of the most common and powerful ways in which we try to understand our fellow humans.” Interviews and interviewing has evolved from being seen as a neutral tool of data gathering to an active contact between two or more people leading to “(...) negotiated, contextually based results.... The focus of interviews is moving to encompass the *hows* of people's lives (constructive work involved in producing order in everyday life) as well as the traditional *whats* (the activities of everyday life) (Ibid.: 698).” The reason I talked to the villagers in Akal and Soda was because I wanted to know how the CDM-registered windmills affected their everyday life. This is easier to achieve through semi-structured interviews than through pre-determined questionnaires. Semi-structured interviews have an aura of informality around them; the researcher maintains a tone of “friendly” chat while trying to remain germane to the issues she wants to know more about (ibid.). The informants can talk freely, giving semi-structured interviews a greater breadth than structured interviews.

Before the fieldwork, I prepared question guides (interview guides) and, during interviews, adhered to the questions as much as possible. For comparison purposes, I posed the same questions to residents of both villages and to the wind power companies. I repeated the same questions in different order, asked follow-up questions and requested elaboration on details.

In both villages I interviewed a group of men who were gathered in a common hut normally used for village council meetings (*panchayat*). I would sit in the middle while the men sat around me. The interviews were recorded and I also took notes. In Soda the men were more open and willing to talk, and the interview lasted for 45 to 50 minutes and I was allowed to take pictures. In Akal the group was less willing to talk, and the interview was over in half an hour. In both villages the group of men consisted of between 10 to 20 persons, so I decided to treat their replies as those of one respondent. In Soda the men talked freely, while in Akal it was usually one man in the group who spoke. Later on, we were joined by two men who worked as security guards on the windmill sites who explained their work. Group interviews can pose a methodological problem, because there is little room for personal opinions in a group, especially if they are in opposition to the main view. It is also difficult to generalize the results of a group interview because the outcome might be a product of “groupthink” (ibid: 705).

The main objective of the visits to the villages was to find out if the claims of the PDDs were true for the villagers. All three PDDs claim that the projects have made a contribution to employment in the impacted areas and provided the villages with other social benefits, such as health care services. The managers in the three wind power companies made the same claim. Because the entire village is supposed to have benefited from the CDM projects, it is important to get a group perspective on the impact of the CDM project.

Another methodological problem is that I was only able to interview men, which of course affects the data. Denzin (in Fontana and Frey 2003) states that gender filters knowledge. This means that the sex of the interviewer and the sex of the respondents have a role to play in the interview situation. There are cultural borders within a social system that places greater value on men, and where women's opinions and problems are often overlooked. It is possible that the men I interviewed had an objection to me being there because I am a woman. I felt this especially in Akal village, where the men were less open to my questions and, according to my interpreter, did not approve of Western women coming to interview them.

In each village I presented myself as a student from Norway who was there to study the windmills, and I stressed that I did not have anything to do with the wind power companies. At the end of each interview session, I asked if the villagers had any questions for me. This revealed that even though I had specified several times that I would not pass the information I got from the villagers to the wind power companies, they were still under the impression that I had a connection with the companies. In both villages the men asked me to tell the companies about the problems they were facing because of the windmills, and that they wanted more employment. I had to explain to them again that I was not in a position to pass on information to the companies. Nevertheless, their perceptions might have influenced the information they provided. This was very difficult for me because earlier I had spoken to the companies and asked why they did not employ villagers. They said that they had employed as many as they could but the remaining jobs were reserved for skilled workers. When I was interviewing the villagers, I knew that there would not be any more jobs for them. I felt that this was something I could not tell the villagers. It would have felt wrong to crush their hopes.

## 2.2 Assessing sustainable development

To form a basis for evaluating how the CDM projects contribute to sustainable development in Jaisalmer, I chose a methodology developed by Olsen and Fenhann (2008). They have surveyed 744 project design documents (PDDs) in the CDM Pipeline[10] and developed a new methodology for a sustainability assessment of CDM projects. They argue that the benefits of sustainable development should be "real," even if they are not "measurable" in the way GHG reductions are. One of the goals of this methodology is to simplify the host country's verification of sustainable development benefits presented in the PDDs.

The methodology consists of a conceptual framework with a taxonomy of dimensions and criteria inspired by existing methodologies (Olhoff et al. 2004, Sutter 2003) and what the PPs themselves emphasize when they refer to sustainable development. I've chosen to use this methodology because it's one of few developed from an extensive review of a large number of PDDs. It is also built on the existing terminology for sustainability assessments. Olsen and Fenhann have divided the benefits into four categories: environmental, social,

[10] The projects were submitted for validation by 3 May 2006.

economic and other benefits. In my adaptation of the methodology, I've chosen to leave out environmental benefits because I did not have the time and other resources to assess the environmental benefits of the projects in Jaisalmer. The details of the methodology will be presented in chapter 9.

## 2.3 Other stakeholders

As I showed in figure 1, the CDM is a tool that works on three levels: international, national and local. In India there is also a regional level, since the country is a republic with a federal structure. The states are given extensive powers over policies and laws. In order to see some of the interaction between these levels, I chose stakeholders from each echelon. The local stakeholders are the villagers and the wind power companies. The interview list can be found in the appendix.

### 2.3.1 Local

The companies that I interviewed are all located in the city of Jaisalmer and have set up field offices in the city. These are Enercon India, RRB Energy and Suzlon. Each company has projects in the CDM project cycle located close to either Soda or Akal village. Through the CDM Pipeline I found projects – Enercon and RRB Energy – that entail some degree of technology transfer. Before my fieldwork I was interested in the degree of technology transfer in the context of the CDM. However, I had to change my initial research question because several informants involved with the CDM system in India told me that there had been no technology transfer. Wind power companies treat the projects in the same way regardless of their CDM status. I will come back to this issue in chapter 6. I therefore chose Suzlon to compare how a fully indigenous company tackles CDM, technology transfer and the local inhabitants.

Through the CDM Pipeline I searched for all wind projects in Rajasthan. The projects are at the stages of registration and issuance (Enercon and Suzlon) and validation (RRB Energy). Then I researched the relevant PDDs and looked for statements of technology transfer; among registered projects, there was only one PP claiming technology transfer. In order to find more projects claiming technology transfer, I had to expand my search and include PDDs in the stages of validation and under review. The rejection rate for Indian CDM projects is very low: 35 of all 270 projects have been rejected (UNEP Risoe CDM Pipeline June 2009), and therefore there is a good possibility that the projects waiting for validation will get approved. I contacted these companies via phone when I arrived in Delhi. I was told to contact their field offices in Jaisalmer when I arrived there.

### 2.3.2 Enercon

Enercon was chosen based on its PDD, in which the company states that it "… has secured and facilitated the technology transfer for wind based renewable energy generation from Enercon GmbH, has established a manufacturing plant at Daman in India …" (Enercon PDD 2005: 5). The company claims there has been technology transfer because of this project. The project, which was registered in 2006, is a bundled[11] wind project with the capacity of 58, 2 MW. According to the CDM pipeline, 162,638 CERs (i.e., the reduction of 162,638 tonne CO2e) have been issued for the period July 2004 to June 2006.

One of the main reasons to go for bundling is to save cost in the CDM approval process. In Enercon's case, there are eleven PPs, excluding themselves, and it would be too costly and time-consuming for all of them to apply for CDM registration. I visited the Jaisalmer office of Enercon twice and interviewed two of the service managers there. The first interview took place in their joint office and was taped, while the other interview was conducted with one of the service managers while visiting the site of the CDM project. The visit lasted for about four hours, during which the service manager constantly got interrupted by his cell phone, as well as other people who accompanied us on the visit. The

[11] A bundled CDM-project means that several smaller windmill sites have been brought together and form a unified project, but without losing the "… distinctive characteristics of each project activity." (CDM Glossary: 12). The characteristics are: technology, a measure of how much GHG the project reduces, physical location and which methodology the PPs have used to measure reduction of GHG (simplified baseline methodology) (ibid.).

interruptions made it difficult to record the entire fours hour, but I did take extensive notes during the conversation with the service manager.

### 2.3.3 RRB Energy

RRB Energy was also chosen based on its PDD, even though it does not claim technology transfer. The company was formerly known as Vestas RRB Energy Limited and was one of the first wind-power companies to be established in India. In 1987, the Danish wind company Vestas established a joint venture agreement with Rakesh Bakshi, now the managing director of RRB. The Danes offered extensive technological cooperation to their Indian partners, but in 2006 Vestas RRB Energy Limited became a wholly owned Indian subsidiary. The project consists of 17 wind-energy generators (WEGs) (10.2 MW) close to Akal village, where the Rajasthan Renewable Energy Corporation (RREC) is the PP; RRB Energy provided the WEGs and is in charge of operation and maintenance. The company has a small office in Jaisalmer and I interviewed the manager during a visit to one of their sites and in his office. The site was not the site of the CDM project, but a site which was being built. The entire interview took about one and half hours. I recorded the interview, but unfortunately the recording was damaged, so the interview with the manager is based on my notes.

### 2.3.4 Suzlon

This company was chosen for comparative reasons: it is a fully indigenous wind power firm and one of the largest in the world. I wanted to know if there were any differences in how Suzlon tackled CDM, technology transfer and the local inhabitants. Suzlon operates several registered projects in the Jaisalmer area; the site I visited with the Suzlon engineer is in Baramsar. The company has three registered CDM projects (Suzlon PDD 2006 a, b, c) close to Soda village with a total capacity of 13.75 MW (9 WEGs). These three projects have been issued 48,064 CER's. Suzlon has an employee in Jaisalmer which handles CDM projects. I interviewed him in his office and several days later he showed me the site of the Baramsar CDM project. The whole session with Suzlon took about three hours and the office interview was recorded.

### 2.3.5 Regional

On the regional level, the Rajasthani state government has set up a nodal agency – the Rajasthan Renewable Energy Corporation Limited (RREC) – to facilitate the establishment of renewable energy in the state. They are also the PP for the CDM project close to Akal village operated by RRB Energy. Due to several public holidays, I was unable to meet with them, but did send them a questionnaire via e-mail that was answered by one of the senior staffers in charge of wind energy. This is used in the further analysis.

Since I was unable to personally interview high-ranking RREC representatives, I contacted a local representative that is based in Jaisalmer. He manages wind projects of which the RREC is a customer, including the project in Akal village. He was extremely unwilling to say anything about CDM, as he didn't know anything about it. Surprisingly, he was willing to meet with me twice, and I convinced him to answer some questions. He explained state policies and how some of the villagers reacted to the windmills. His contribution is used as background material.

### 2.3.6 National

The national-level stakeholders are: The Ministry of Environment and Forests (MoEF), which serves as the DNA; the Ministry of New and Renewable Energy (MNRE); and the Indian Wind Energy Association (InWEA). During my fieldwork in India I was able to interview a director from MNRE and the secretary general from InWEA referred to as Subramanian. The DNA has an informative good website which I have used for information.

I also interviewed Amit Kumar, director of the Energy-Environment Technology Development Division at The Energy and Resources Institute (TERI). TERI is the largest Indian research institute with a focus on energy and development.

Kumar was recommended as an expert on the wind power sector. Viapradas, a director in the consultancy firm Senergy Global, was also interviewed. Senergy Global is one of the largest CDM consultants in India and has 59 registered CDM projects.

During my fieldwork I was invited to a large CDM conference in Delhi called CDM Bazaar, which is how I got in touch with the director from MNRE. The conference was organized by the German Ministry of Environment, MoEF and the German development agency GTZ. CDM bazaar was meant to be a capacity-building conference for those interested in participating in the CDM system. It was also a way for investors to meet those who have established renewable energy projects. Some of the conference material is used as a secondary source in chapter 7.

## 2.4 Anonymity

During my fieldwork I tried to use a tape recorder as much as I could to ensure accuracy of data. All of my informants agreed to be recorded, except for the director from MNRE. He stated that he would be happy to be recorded, but, if so, he would not say his honest opinion. The interview with him is based on my notes. I interpreted his reluctance to be recorded as a preference for anonymity. The names of the managers in Jaisalmer are not included. They provided some personal information about their job performance which could invite repercussions from management. They are rather representatives of a company view on the matters I interviewed them about.

# 3. The theory of ecological modernization

> "Recently, debates about sustainable development have come to be dominated by a particular interpretation- ecological modernization- which is garnering the widespread support and interest among a range of actors including business, governments, international organizations and more mainstream environmental groups" (Connelly and Smith 2003: 5).

The theory of ecological modernization emerged in the early 1980s out of the experience of so-called front-runner countries in Western Europe and Japan (Germany, Sweden, the Netherlands and Denmark), which designed and implemented national policy directed at transforming markets in a more environmentally sustainable direction (Mol and Sonnenfeld 2000, Mol 2001). Ecological modernization can be defined as a market-based system of production and consumption (capitalism) that works with and alongside environmental improvements and positive environmental reforms. The basic idea is that *a clean environment is good for business*. It produces healthy and happy workers while companies can profit by developing conservation technologies, selling green products, more efficient use of materials or providing high-quality inputs into production (Dryzek and Schlosberg 2005).

Ecological modernization is a theory of change that promotes a market-based solution for environmental problems. The solution can be based on development of new technology to replace outdated and polluting forms of production. In this chapter I will argue that the CDM, which is a market-based and technology-oriented mechanism, was formed on ideas coinciding with ecological modernization.

In section 3.4 I will show how ideas of ecological modernization permeated the work for a UNFCCC, and how Jänicke and Jacobs' (2005) technical-economical definition of ecological modernization shaped the Kyoto Protocol and the CDM. The political struggles and bilateral agreements between different countries have also made an impact on the final layout of the CDM, but in this thesis I have chosen only to focus on ideas of ecological modernization.

## 3.1 The origins of ecological modernization

The theory of ecological modernization developed out of a notion that "(…)delinking and decoupling of material from economic flows(…) (Mol and Sonnenfeld 2000:6)" can result in a decline of natural resources used and emissions, regardless of the pattern of economic growth. Mol and Sonnenfeld, two influential theorists in the field, state clearly:

> "More production and consumption in economic terms (GNP, purchase power, employment) do not have to imply more environmental devastation (pollution, energy use, loss of biodiversity). Within principally the same modern institutional lay-out (a market economy, an industrial system, modern science and technology, a system of welfare states etc.) we can thus look for – and design – radical environmental reforms" (ibid: 36).

Here, radical means achieving a "greening of business as usual" and thus a greening of future economic growth. This can be done by maintaining high environmental standards as set by governments. The key prescription is the separation of economic growth from rising energy and material inputs: i.e., producing "more with less" (Barry 2005).

Ecological modernization has caught on in widespread circles, as depicted by the quote from Connelly and Smith (2003) in the beginning of the chapter. Ecological modernization has been part of the approach to sustainable development because the two have an overlapping interest in reconciling economic growth and environmental concerns. Ecological modernization stemmed from the tradition of environmental sociology, putatively founded by the German sociologist Joseph Huber (1982, 1985). Ecological modernization is considered a successor of old modernization theories and as an extension of the Enlightenment project (Mol and Sonnenfeld 2000). For some theorists in the discipline of ecological modernization, like Mol, it has a status of a social theory, while others, such as Weale, see it as a "... new departure in environmental policy principles" (Weale 1992:79). Ecological modernization has been utilized in analysis of environmental politics and policy in the industrialized North during the late 1990s and 2000s. It has also developed and spread from its original and

German and Dutch context to become an environmental analysis of the wider industrialized world (Barry 2005).

In times of ecological crisis, which have prevailed since the mid-1960s, ecological modernization aims to analyze how modern societies transform their physical, social and, most importantly, institutional organization. The theory acknowledges that there is a necessity for a fundamental reorientation to remove the “structural design flaws” that have led to environmental problems. One structural design flaw of modern societies is the widespread notion of treating the environment as an external cost[12] in industrial production.

Ecological modernization goes a step beyond environmental economy and, instead of putting a price on the environmental external cost, it argues for a rationalization of production and consumption. This means embedding environmental factors in the institutional design of production and consumption. Mol and Sonnenfeld (2000: 27) call for an “ecological rationality” that is independent from economic rationality. More concrete examples of this type of ecological rationality are: environmental accounting and bookkeeping, annual environmental reports, green GNP, and environmental efficiency in buildings (ibid.).

The state has a role as a regulator of production by setting emissions standards, using market instruments and encouraging voluntary self-regulation in the industrial sector. Examples of this regulation are “polluter-pays” legislation, the precautionary principle and mandatory environmental impact assessments (Barry 2005).

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[12] External cost, in economic vocabulary, is a detrimental impact of an externality. Externalities, or impacts, arise after an economic transaction and affect a third party that was not directly involved in the transaction. The environment is regarded as a third party. The reason environmental economists wish to put a price on external cost, is because prices of products and services do not reflect the full cost of producing and consuming those services and products. The environment has been regarded as free of cost. This means that impacts from production that, for example, results in air pollution are imposed on the society (consumers) as a whole, while it is only the producers who reap the benefits. If producers count in environmental external costs, then the competitive market would not overproduce bad goods such as air pollution.

There is no contradiction between (neoclassical) environmental economics and ecological modernization, according to Barry (2005). His view is that ecological modernization has gained widespread acceptance exactly because of its language of economic rationality, meaning that for both theories environmental interests are only considered when they can be translated into a cost-benefit calculation. He labels this “economizing the environment” rather than the more radical implications of “ecologising the economy.”

It is important to bear in mind that ecological modernization works hand in hand with the predominant capitalist system. This results in a hierarchy of priorities where ecological criteria are never given absolute precedence over societal, economic or institutional criteria. I will elaborate more on this in relation to the Kyoto Protocol in section 3.5.

## 3.2 Ecological modernization and capitalism

In the earlier period, in the 1980s and 1990s, Maarten Hajer and Joseph Huber led the debate on technological innovations as an engine for pushing the limits of economic growth forward. This resulted in ecological modernization theory being criticized for praising “the expansion of limits” view. Recently, major theorists in the field have embraced the nuances of a capitalistic world view. Ecological modernizations theorists do not hold the position that capitalism is essential for environmentally sound production and consumption, or that it has no role in environmental degradation. Ecological modernization recognizes that:

1. Capitalism is changing constantly and one of the main triggers of change is related to environmental concerns.
2. Environmentally sound production and consumption is possible under different “relations of production” and each production mode requires its own environmental reform program.
3. All major, fundamental alternatives to the current economic order have proved unfeasible according to various criteria (Mol and Sonnenfeld 2000:22-23).

Adherents of ecological modernization hold that it is about redirecting and refocusing “(…) “free market capitalism” in such a way that it less and less obstructs, and increasingly contributes to, the preservation of society's sustenance base in a fundamental/structural way" (ibid: 23). Ecological modernization theorists look at five clusters[13] of institutional and societal restructuring and recognize that an increasing role is played by economic agents and market dynamics as carriers of ecological restructuring[14] and reform.

In terms of policy, ecological modernization represents"equilibrium" whereby supply (the development of a market for more environmentally friendly products) and demand (increasing pressure on governments to provide protection from and tackle environmental problems) meet. It is a compromise between dominant economic interests and imperatives, specific ecological interests (non-radical and partial), economic globalization and political legitimacy and support.

(Martin Jänicke (1997, 2002, 2005), in line with Hajer (1995) and Huber, has focused a lot of his work on the changing role of science and technology. These changes are not only evaluated on the grounds of their detrimental impact on the environment, but also valued for their potential for curing and preventing environmental problems. This focus has given ecological modernization the reputation of providing a quick-fix technocratic solution to the ecological crisis (Mol 2001, Connelly and Smith 2003). The idea is to *push a sector towards environmental sustainability, not by cancelling its detrimental mode of production, but by making it "greener" with the help of technology*. This is the technical-economical definition of ecological modernization.

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13 These five clusters are: The changing role of science and technology, increasing importance of market dynamics and economic agents, transformations in the role of the nation-state, modifications in the position, role and ideology of social movements and changing discursive practices and emerging new ideologies.

14 Ecological restructuring refers to ecological considerations as the triggers for change in institutional processes in industrialized societies. Ecological modernization theorists analyze and judge economic processes of production and consumption, while at the same time acknowledging that these processes are designed and organized from both and economic and ecological point of view. The reason why ecological restructuring is analyzed as an institutional change is because theorists believe that these alterations are here to stay. They are not as Mol puts it, and in the same breath criticizes ecologism: "mere window dressing" (ibid: 53).

## 3.3 Ecological modernization and technology

"The greening of business as usual" is a disputed notion because it is derived from a legacy of modernization theories such as Rostow's "The Stages of Economic Growth" (1960) and the so-called "Environmental Kuznets Curve"[15]. The notion implies a latent potential for achieving sustainability from *within* a business sector. Ecological modernization claims that as the industrial society moves towards the later stages of modernization a need arises to "(…) internalize environmental impacts in order to ensure future production inputs (…)" (York and Rosa 2007: 274). This sets mechanisms in motion that eventually result in an ecological transformation to a sustainable society.

Returning to Jänicke and the work on technology as a vehicle for societal transformation, his definition of ecological modernization is reduced to its technical-economic sense. It is understood as *the innovation and diffusion of marketable, environmentally friendlier applied technologies, including the innovation and diffusion of supporting policies* (Jänicke and Jacob 2005). Modernization is the process of:

> "(…) continuous improvement of procedures and products; it's a compulsory necessity in the capitalistic industrial societies driven by the forces of competition which generates innovative or efficient technologies. It is possible for ecological modernization to *influence the direction* of modernization" (ibid: 176).

Influencing the direction of societal development with the help of technology also includes bypassing some stages of "unwanted" industrial development. Among the unwanted side effects of industrialization are pollution, natural resource depletion and GHG emissions. Jumping over these stages and to a stage

[15] The Environmental Kuznets Curve (EKC) hypothesizes that the relationship between per capita income the use of natural resources and/or the emission of wastes has an inverted U-shape. According to this specification, use of natural resources and/or waste will increase with income. But there is a turning point from which environmental degradation will decline with income. Reasons for this inverted U-shaped relationship are hypothesized to include income-driven changes in: (1) the composition of production and/or consumption; (2) the preference for environmental quality; (3) institutions that are needed to internalize externalities; and/or (4) increasing returns to scale associated with pollution abatement. Subsequent statistical analysis, however, showed that while the relationship may hold in a few cases, it could not be generalized across a wide range of resources and pollutants (Richmond et al. 2006).

with environmentally friendlier industrial production is known as "*leapfrogging*". The leap requires the transfer of technology from one lead country or market[16] to a country that has not developed the technology, but has the capability and capacity to utilize it (Kaplinsky 1990). There was a desire that the CDM would function as an international transfer mechanism for ESTs, even though this is not explicitly stated in article 12 of the Protocol, which outlines the mechanism (UNFCCC 1998). I will return to the implications of technology transfer through the CDM in chapter six and eight. In line with the theory of ecological modernization, and stated as one of my subsidiary aims, it is appropriate to pose the question: in what way has the CDM contributed to technology transfer of wind power technology to India?

Jänicke and Jacob (2005) define ecological modernization in its technical-economical sense because they claim that policies based on technologies and innovations are easier to introduce and implement than policies requiring a transformation of institutional, structural and cultural dimensions in a society. Technology-innovations policies also have the potential for environmental improvements within the market system. For these two theorists, ecological modernization must include marketable solutions. It falls on the private sector to develop, test and market new environmentally friendly innovations and production methods while the state acts as an enabler. The ecologically modernized state is supposed to support, coordinate, and encourage technological innovation and greater efficiency in the use of resources and energy. Sustainability and "greening" can be achieved best with state policies on technology and innovation, through subsidies and research and development (R&D), investments in technology, setting environmental taxes, etc. (Barry 2005, Jänicke and Jacob 2005). Such policies are in accord with one of the twin objectives of the CDM: namely, contribution to sustainable development in non-Annex I countries. Mol and Sonnenfeld's (2000: 24-25) retort to those who

[16] A lead market is a country that introduces a technology/innovation subsequently adopted worldwide. These are usually high-income countries because they can afford the necessary investments in research and development to enable innovation of new technologies (Jänicke and Jacob 2005).

criticize the notion of the "greening of business" is that their observations relate to the early periods of ecological modernization theory. Recent contributions to the theory have departed from assuming that environmental interests are inherent in the modernization process. Here I refer again to Jänicke and Jacob and their definition of modernization to show that these ideas are still alive and kicking.

## 3.4 Ecological modernization and global environmental issues

During the late 1960s and 1970s, a wave of concern for the environment washed over the developed world. People and governments became aware of the degradation that industrial modes of production brought upon their local environment. Later, and following the influential "Limits to Growth" report by the think tank Club of Rome (Meadows et al. 1972), the scope was widened to include the global dimension of the environment. "Limits to Growth" advanced the notion of finite natural resources and catastrophic consequences when their exploitation was coupled with exponential population growth. The report highlighted the inequality between Northern industrialized countries consuming resources and countries in the South lagging far behind in their industrial and human development. The international environment was the topic of the United Nation's first environmental conference in Stockholm in 1972, titled "UN Conference on the Human Environment." This first "Earth Summit" produced a framework for further international collaboration on environmental issues, and its participants agreed on the establishment of the United Countries Environment Programme (UNEP). Although it is a small agency in the UN system, UNEP is credited as catalyzing strengthened and expanded international coordination by organizing several pivotal conferences, publishing reports, setting up influential scientific panels and, most importantly, creating environmental law through treaties and conventions (Langhelle 2000, Mol 2001, Connelly and Smith 2003).

### 3.4.1 The divide between radicalism and pragmatism

Some theorists characterize the period from the late 196os to the late 1970s as "the second wave of environmental concern" in the Western industrialized countries [17] (Mol 2001:49). The period was marked by the notion that the world was in dire need of a fundamental restructuring of the social order. If we are to keep the planet alive, we must alter the system –created by mankind– which depletes its resources and renders it uninhabitable for mankind and other species. The call for fundamental reforms in favor of the planet is often labeled "ecologism" or "radical ecologism" (Garner 2000). The movement was strongly non-anthropocentric, meaning that nature was assigned value for its own sake and that ecologists had a "(…) commitment to social justice within human society and between humans and non-human nature" (ibid: 11). Reform was needed to create a new type of society with new types of institutions and values. The ecologism movement dissipated into much talk and little action, according to Mol (2001). The largest institutional success of the ecologists was the creation of:

> "(…) several government departments for environment, expanding environmental legislation and planning, a growing number of international environmental organizations and treaties, and a rapid increase in the number of and membership of non-governmental environmental organizations" (ibid: 50).

This is not radical enough for Mol because ecologism did not lead to actual restructuring of the basic institutions (the industrial structure, economic relations and scientific-technical developments) that were responsible for environmental deterioration (ibid.).

In stark contrast to radical ecologism, Mol thus presents the emergence of a more pragmatic approach to solving environmental problems: ecological modernization. It is labeled a pragmatic approach because it works with the current social and economical order: capitalism. Mol aims to expand the

[17] The first wave of environmental concern was the nature conservation movement in the beginning of the 19$^{th}$ century and its focus on establishing national parks.

ecological modernization theory outside its European setting and to determine if it is valuable for understanding international and global environmental reforms. He classifies ecological modernization theory as "(…) the centripetal movement of ecological interests, ideas and considerations involved in social practices and institutional developments, which results in the constant ecological restructuring of modern societies" (ibid: 59).

I have already mentioned the creation of UNEP and its catalyzing role in global environmental cooperation. Mol mentions that most ecological modernization studies have focused on actual environment-induced transformations in social practices and institutions. These changes fall into the earlier mentioned five clusters, including transformation of the traditional role of the nation-state. Ecological modernization sees an emerging role for international and supra-national institutions that undermine the role of the nation-state as the main player in the creation of environmental reforms (ibid.). Even though the central duty of the state in ecological modernization is as an enabler, Mol argues that this function of the nation-state has been lost to the supra-national regimes, specifically the EU. The EU has been a driving force for defining and implementing environmental regulation among its members, as well as in the UNFCCC and Kyoto Protocol negotiations.

### 3.4.2 Ecological modernization on the road to Rio 1992

Mol (2001) sees these transformations of institutions and the creation of new institutions in light of events after Stockholm in 1972. North/South issues were raised on the international arena, but little actually came of it. The gap between the North and the South was widened during the economic crisis in the 1980s when developing countries became highly indebted, and the situation for a large percentage of the world's population worsened. All of these events exacerbated the pressure on natural resources, and the world was shaken by reports of famine disasters in Uganda, Sudan and Ethiopia. In 1983, the World Commission on Environment and Development (WCED) was established by the UN. The commission's report “Our Common Future”, published in 1987, established a firm link between development and the environment by coining the term sustainable development. In Mol’s view, this marks the beginning of the third wave of environmental concern and a surfacing of the idea of ecological modernization (Mol 2001).

The term also brought together diverging interests: i.e., the concern for a sustainable ecological development and economic growth. This marked the emergence and eventual approval of a more pragmatic approach to environmental issues. “Our Common Future” looks for a solution in cooperation with the predominant societal system which is capitalism. Prior to the report, the scientific community, through the World Meteorological Organization (WMO), was raising awareness about global warming induced by anthropogenic emissions of GHGs (Boehmer-Christiansen 1996).

“Our Common Future” stated that limits to global development are tied to access to energy and the ability of the biosphere to absorb the byproducts of energy consumption, i.e., GHG. The emphasis on energy in “Our Common Future” stemmed from the WMO’s concerns about global warming and its effects. The commission was one of the first UN institutions to set targets for reducing energy consumption in developed countries by 50 percent over the next 50 years, and increasing energy consumption in developing countries by 30 percent (Langhelle 2000). Just a year after the report was published the Intergovernmental Panel on Climate Change (IPCC) was established by UNEP and the WMO, and paved the way for *the* Earth summit: the United Countries Conference on Environment and Development, better known as Rio 1992. The summit followed up on the concept of sustainable development and established it as a guiding principle for several treaties and conventions, among them the UNFCCC. Still, the way of thinking about the development process of countries was in the spirit of ecological modernization. Connelly and Smith (2003: 240) say it best when describing the Rio process: “…the logic of ecological modernization underpinned much of the negotiations.”

## 3.5 Ecological modernization and the Kyoto Protocol

In Rio, 150 countries signed the UNFCCC and it entered into force two years later. UNFCCC has no binding targets on emission reductions and no commitments for financial and technological transfer to developing countries. The ambiguity is clearly stated in the convention's ultimate objective in Article 2 (emphasis added):

> The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, *stabilization of greenhouse gas concentrations in the atmosphere* at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved *within a time-frame sufficient to allow ecosystems to adapt naturally* to climate change, to ensure that food production is not threatened and *to enable economic development to proceed in a sustainable manner* (UNFCCC 1992).

The statement about enabling economic development is in the spirit of ecological modernization and "(…) the dominant vision of development was that of ecological modernization model with the emphasis on the necessity of continued economic growth" (Connelly and Smith 2003: 240).

Gone was the radical spirit of the 1970s. The main principles in article 3 of the UNFCCC take a pragmatic stance towards climate change. Article 3, paragraph 3 emphasizes the precautionary principle: as long as it is done in a cost-effective manner. Since then, the mantra for combating climate change for Annex I countries has been cost-efficiency (emphasis added):

> The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with *climate change should be cost-effective so as to ensure global benefits at the lowest possible cost* (…) (UNFCCC 1992).

The Earth summit in Rio in 1992 spurred further action and collaboration in the global environmental arena. Three years later, the main decision-making body of the UNFCCC, the COP, reviewed the institutional arrangement for achieving the convention's ultimate objectives and found it insufficient. Further negotiations were needed to reach a firm commitment for stabilizing the concentrations of GHGs in the atmosphere.[18] After two years of intense negotiations, the Kyoto Protocol was adopted 11 December 1997 (UNFCCC 1998, Depledge 2004).

### 3.5.1 A global marketable solution

The logic of ecological modernization runs all the way from Rio to Kyoto, given that the Protocol is an update of the convention, only with stronger and legally binding commitments to curb GHG-emissions. The introduction of economic concepts and mechanisms into global agreements such as the Kyoto Protocol is central to ecological modernization (Barry 2005). Flexible mechanisms which put a price on carbon, such as the CDM, JI and emissions trading, were invented to reorient global structural design flaws. There is "... a penchant within ecological modernization for market-based and entrepreneurial solutions, which turn collective ecological problems for society as a whole into selective economic opportunities for market actors (aided by the state)" (ibid: 310).

Mol (2001) claimed that the nation-state had lost its sovereignty to supra-national environmental regimes such as the EU. The example he provided is Germany's reluctance to accept emissions trading. This was later set aside by the Kyoto Protocol where emission trading is allowed under article 17 both within countries and among them (ibid: 107). Today, Germany is one of the biggest emission traders in the market (Point Carbon 2009). During the negotiations over the Protocol, countries– especially developing countries– were fearful of losing their sovereignty and refused to accept emissions caps. USA and Australia, two of the largest GHG emitters, opted out of the Protocol due to claims that it would harm their national economies. Therefore it's difficult to apply Mol's claim to the Kyoto Protocol and label it as a supra-national environmental regime. It might be more valid to say that regional regimes such as the EU and strong sovereign

[18] In the language of intergovernmental negotiations, an update of the UNFCCC is called a Protocol. The negotiations of Protocols are stated under Article 17 of the Convention.

countries put forth ideas of ecological modernization as a solution to climate change. Such ideas are politically attractive because they do not require major structural changes in the economy when it comes to dealing with environmental issues. The mantra is that we can continue on the same economical path as long as we provide minor technological solutions to production of more material goods and services; it might even be good for businesses that they are offered a chance to expand beyond national borders. Barry calls this “supply-side” policy:

> Thus, ecological modernization is clearly a supply-side, as opposed to demand-side approach to environmental policy. That is, ecological modernization does not engage with consumption issues of either challenging or regulating the demand for goods and services in the economy, nor with issues concerning the distribution of consumption within society. Ecological modernization as a “supply-side” policy, like all supply-side policies, attempts to circumvent, downplay or avoid issues of social or distributional in/justice and in/equality. It does this by obviating the need to engage in politically regulating overall demand, or adjusting the pattern of the distributional consumption, by focusing policy and public attention on the supply, rather than the demand for or distribution of, economic goods and services (2005:311).

Political avoidance of imposing regulation on and adjusting the pattern of demand means that even though there is an increase of use of renewable energy in a society, there is no regulation of where and by whom this energy is used. In other words, it can lead to more production of goods and emission of GHGs.[19] There is no guarantee that renewable energy leads to an improvement in the lives of impoverished people (i.e., human development). Seeing as ecological modernization is a successor of old modernization theories, development is measured as economic growth (increase in GNP), wealth and income, paid employment in the formal economy and an increase in consumption and so forth (Barry 2005). There is no room for including distributional and social aspects of human development (Langhelle 2000).

During the negotiations of the UNFCCC, developing countries pushed for an integration of the principles of sustainable development into the final document.

[19] One example which is relevant for Rajasthan is cement production. The state is the leading producer of cement in India, contributing to 15 percent of the national output (Center for Monitoring Indian Economy 2010). Cement manufacturing contributes to GHG emissions in the chemical process of calcinations of limestone. In the US it is the largest single source of emissions from industrial processes (EIA 2008).

Developing countries did not want to be made responsible for the accumulation of GHGs in the atmosphere. They asserted their right to development, but it was to be done sustainably. The principles of sustainable development were accepted and carried on to the Kyoto Protocol. Sustainable development and ecological modernization have a lot of similarities, which I will touch upon in the next chapter.

# 4. Sustainable development and the CDM

The Kyoto Protocol is based on the principle of "common, but differentiated responsibilities," inherited from the UNFCCC. This principle is formulated around one of three dimensions covered by sustainable development, namely social justice. Sustainable development is a policy framework with implied theoretical lines of approach. However, the mechanisms established in the Protocol are based on the technical-economic interpretation of ecological modernization.

The overarching twin objectives of the CDM are to support sustainable development in developing countries and assist industrial countries in meeting their emission reduction commitments at the lowest price available. Sustainable development in developing countries, as it is stated in article 10 c) of the Protocol, can be achieved with transfer and diffusion of marketable, environmentally friendlier applied technologies, including the innovation and diffusion of supporting policies (cf. Jänicke and Jacobs's definition of ecological modernization).

Sustainable development has as an unequivocal emphasis on social justice, while ecological modernization, as a "supply-side policy," overlooks this issue completely. I will contend that the CDM is an attempt to fuse these two approaches on policymaking together. The CDM focuses on the similarities between ecological modernization and sustainable development, while the differences are disregarded. The question remains whether this fusion has taken place in real life.

In the next section I will explore the relationship between ecological modernization, sustainable development and the CDM. The two following sections will elaborate on the main pillars of sustainable development, especially the understanding of social justice. The definition of sustainable development used in this chapter was given by the WCED and is:

> (...) “development is sustainable if it meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987: 46).

The core of the concept of sustainable development is humans and involves human needs, not the environment (Lafferty and Langhelle 1999). There is a similarity with ecological modernization theory here, because ecological criteria are similarly subordinate to societal or institutional criteria. This will be explained further in section 4.2.

## 4.1 The need for sustainable development

Prior to the Rio summit, several industrialized countries pushed for equal responsibilities for stabilizing GHGs. These countries were severely criticized and accused of “environmental colonialism” (Agarwal and Narain 1991). NGOs in developing countries claimed that the basis from which industrialized countries wished to allocate responsibility for GHG emissions was fundamentally wrong. Industrialized countries failed to take history and equity into account. Colonialism did not end when the former rulers retreated; they still reassert their power and dominance, thus shaping circumstances in developing countries. The global environment is one venue in which the effects of colonialism are manifest. Agarwal and Narain rejected the notion of accounting for GHG emissions regardless of their sources and origins. Instead, GHG emissions should be divided into “luxury emissions” and “subsistence emissions,” the former generated by over-consumption in the West and the main reason for the environmental problem, while the latter are produced by the poor to meet their basic needs (ibid.).

This notion imbues the principle of “common, but differentiated responsibilities,” because developing countries are allowed their “subsistence emissions” in the first commitment period of the Kyoto Protocol (2008-2012). Still, the intention of the UNFCCC has always been that once the industrialized countries “(…) have shown leadership and started to reduce their emissions, developing countries will follow their lead" (Depledge 2004: 37). This is known as the "leadership paradigm."

Industrialized countries can achieve their binding targets by utilizing flexible mechanisms such as the CDM, JI and emissions trading. The mechanisms are market-based and in line with the current capitalist system. This is prescribed by the central notion of ecological modernization and sustainable development. The CDM is premised on the assumption that ecological considerations when doing business will result in a win-win situation for those participating. The circle of winners is expanded through the Kyoto Protocol because of the global dimension and effects of climate change; the private businesses who promote ESTs get to expand to new markets and the developing countries and their citizens get newer and more sustainable energy sources. In the long run, it is the planet itself that will benefit because there will be less GHG emissions from countries climbing up the development ladder, while the industrialized countries are obliged to stabilize their own emissions.

In addition, Mol and Sonnenfeld (2000) claim that:

> (…) "actual social practices and institutions involving society-nature interactions, are already transforming to a major extent within the boundaries set by the current institutional order, showing that a tight coupling of environmental improvements and radical social change can at least be questioned. There is no – or better: no longer any – simple one to one relationship between radical environmental goals and radical social transformation, as eco-centrists seem to believe" (ibid: 35).

The latter applies well to the intention of the Protocol and especially in the CDM. A radical environmental goal is curbing GHG emissions by introducing ESTs and allowing trade between those who emit small quantities of GHGs and those who are off the chart. Radical social transformation is altering the sources of energy supply and system away from carbon.

An ecological focus amid the conduct of business is also part of sustainable development. The WCED operates with a win-win ethos and encourages economic growth as long as it's environmentally and socially sustainable. That implies a type of growth which is less material- and energy-intensive and is kept within the bounds of what is ecologically possible (Langhelle 2000).

The definition of sustainable development given by the WCED has a dynamic character. To pursue a path of sustainable development means resolving trade-offs between economic, social and ecological concerns (Ruud 2006). These concerns can be explained like this (Ruud, lecture 13.10.2006):

1. **The social dimension:** Principles and criteria for policies designed to: (A) satisfy the "essential needs" of "the world's poor" – South and North; present and future generations.
2. **The economic dimension**: Principles and criteria for policies designed to: (B) achieve stable economic performance adequate to achieve (A).
3. **The environmental dimension**: Principles and criteria for achieving (A) and (B) without damaging the long-term functionality (sustainability) of natural life-support systems – locally, nationally, regionally and globally.

The dynamic character of sustainable development implies that one can expand the carrying capacity, in ecological sense, for a resource by gaining new knowledge or inventing new technology (Langhelle 2000, WCED 1987:43). It is therefore legitimate for developing countries to exploit their non-renewable energy resources, such as coal, in order to provide energy for their poor population. However, the WCED stated that there are ultimate limits. Implicitly this means that technology and social organization are variables that can be manipulated in such a way that changes in those variables, in theory at least, can make *economic* growth possible *within* the limits set by nature (Langhelle 2000). Technological innovation and changes in societal structures are also key features in ecological modernization; however ecological modernization does not acknowledge that there are limits to economic growth.

In either case, both approaches fit well into the context of the Kyoto Protocol and the CDM. Developing countries can expand their energy base if they make use of the CDM and thus use alternative forms of energy such as wind power, hydropower, solar power and biomass. An increased access to energy and energy production in general will contribute to economic growth.

The appropriate question to pose here is: has there been a “win-win situation” in the case study of the Indian wind power projects?

## 4.2 Human development

The WCED’s definition of sustainable development has a broad social context. It is a trinity consisting of a social, physical and economic dimension; together “(...) they are related to the level of social and individual welfare that is to be maintained and developed” (WCED 1987: 5).

The definition contains two important concepts: the first is the concept of “needs,” specifically the essential basic[20] needs of the world's poor “(...) to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs” (ibid.). Sustainable development is grounded on two key elements; intergenerational justice, which is justice among succeeding generations, and intragenerational justice, which is reflected in the importance of meeting the needs of the world's poor in the present (WCED 1987, Langhelle 2000). The first key element, i.e. the satisfaction of human needs, is also seen as the primary objective of development.

Development is an ambiguous term and there is no generally accepted definition. It is understood as an all encompassing change. The change occurs at the societal level and the individual level at the same time. Change, in this sense, is both positive and negative. There is a distinction between immanent development and intentional development. The former refers to a spontaneous and unconscious process of development from within, which might entail destruction of the old in order to achieve the new. The latter refers to the deliberate policy and actions of states and development agencies in order to achieve predefined objectives.

[20] Basic needs or primary needs are defined by WCED as jobs, food, water, energy and sanitary conditions. Employment is considered one of the most important needs, because employment is needed for a livelihood (WCED 1987:54).

Development should not be confused with progress, because progress implies continual improvement without any limits. Development, on the other hand, is the process of moving towards fulfillment of a potential (Thomas 2000).

The WCED understands development as intentional where social change is associated with a realization of desired values, principles or actual conditions. In the composite term “sustainable development,” developmental goals have priority over requirements for sustainability (Langhelle 2000). This is where sustainable development and ecological modernization part ways. Langhelle’s comparison of ecological modernization and sustainable development identifies human development as the key difference:

> “As such, ecological modernization is neither concerned with social justice within our own generation (intragenerational justice) nor with social justice between generations (intergenerational justice)” (ibid. 309).

Ecological modernization sees development as more of an *immanent progress of a society as a whole*. Development is inherent in the modernization process, which is a continuous improvement without any limits. Human development is equal to societal development and measured in improved economic growth, wealth and income, paid employment and increased consumption (Barry 2005).

## 4.3 Limits to development

Sustainability, however, has a conditional restriction on human development. The limits to development center on access to energy and the ability of the biosphere to absorb the waste products of energy consumption (Langhelle 2000). Our society’s need for energy is at present time largely satisfied by exploiting a mix of non-renewable resources such as oil, coal and gas. This unsustainable energy system has created the climate change problem. The emphasis on energy use in the report “Our Common Future” (1987) indicates that there is a hierarchy of environmental and resource problems. Energy is one of the most pressing environmental and developmental issues (Langhelle 2000). Such a hierarchy of priorities does not exist in ecological modernization. There are no criteria for deeming one environmental issue more pressing or more important than another (ibid.). In ecological modernization, environmental issues are viewed as a negative outcome of industrial production, and should be avoided by introducing new ways of producing goods and services.

Sustainable development puts climate change and energy on top of the agenda for environmental policy (Langhelle 2000). Sufficient and affordable energy supplies are imperative for economic development and a transformation of societies from agricultural to industrial. Access to energy and energy use has been essential for improving social and economic well-being; it's key to relieving poverty, improving human welfare and raising living standards. Energy is not a goal in itself; it is a means to an end. The end is better health, higher living standards, sustainable economy and a clean environment (IAEA 2005).

Because sustainable development puts the fulfillment of primary needs of the poor first, it implies an increase in the consumption of energy and other natural resources in developing countries. Relieving poverty and raising living standards through adequate access to energy is necessary for human development, but is not without environmental consequences. The negative environmental consequences of increased energy consumption in developing countries can only be legitimized, and thus sustainable, if industrialized countries reduce their use of energy and natural resources in such a way that the future generations are able to cover their needs (Langhelle 2000). From the perspective of ecological modernization, there is no legitimacy for allowing GHG emissions in order to achieve poverty alleviation. Increased consumption is viewed as an inherent part of the modernization process, as long as the negative outcomes of consumption are removed. Consumption in itself is not negative. Addressing environmental problems, such as rising energy and material use, is done out of the concern for securing future profits (Barry 2005).

For developing and developed countries there is no way of achieving sustainable development without access to energy. The issue then becomes what forms of energy are produced and consumed. If the end is to provide electricity for cookers, the means of providing that electricity doesn't have to come from burning of coal. This is where the CDM and the dynamic definition of sustainable development come into play. This is also in line with ecological modernization, because it places an emphasis on providing a technological fix to environmental problems. If sustainable development goals are to be met through CDM projects, there should be an emphasis on providing electricity for the poorest sections of a society. On the other hand, if the CDM follows the ideas of ecological modernization there is no concern for distributional aspects of electricity consumption.

Lafferty and Langhelle (1999) introduce the words “aspire” and “attain” as a way to prioritize between distributional concerns within generations. They interpret the WCED report as allowing for a differentiation among categories of “goods.” Energy is an imperative good for meeting human needs and should be attained by everyone. When the essential needs are met within a generation, consumption should be limited by the fact that everyone (also future generations) can aspire to meet their basic human needs. The present generations should leave as many options open as possible for future generations (Lafferty and Langhelle 1999). This means that the way in which non-renewable resources such as oil, coal and gas are exploited in this generation should “foreclose as few options as possible” (ibid. 46). In other words sustainable development urges present generations to find new ways of energy production, especially in the developing world.

Ecological modernization also invites structural reorientation of the energy system, but as I mentioned earlier, the argument is based on the idea of redirecting and eliminating environmentally harmful ways of producing energy. Either way, both arguments are in line with the intention behind the CDM. The outcome, on the other hand, is quite different if the CDM is executed according to the principles of sustainable development or ecological modernization. The execution of CDM projects is something which I will focus on in chapter 9.

## 4.4 Contribution to sustainable development through the CDM

In the Kyoto Protocol, and therefore the CDM, the meaning of sustainable development is to be defined by each nation. This is also in line with the WCED report: "No single blueprint of sustainability will be found, as economic and social systems and ecological conditions differ widely among countries. Each nation will have to work out its own concrete policy implications (WCED 1987:40)." Developing countries wanted control over the definition of sustainable development because they were concerned about their sovereignty and unwilling to accept externally determined sustainable development priorities (Voigt 2008). When countries choose to be part of the CDM system and establish DNAs, they also have to define their sustainable development criteria. In the case of India, their chosen criteria are: social well-being, economic well-being, environmental well-being and technological well-being. In the next chapters I will explore further the indicators for social well-being, economic well-being and technological well-being. For now it is sufficient to say that the Indian DNA's hope for the CDM projects is that they "(...) should be oriented towards improving the quality of life of the poor from the environmental standpoint" (CDM India b).

Several CDM researchers and NGOs have expressed concerns about leaving the assessment of how a project contributes to sustainable development solely to the national DNAs (Sirohi 2007, Voigt 2008, Wara 2008, CDM Watch 2009). They are concerned that a subjective approach to sustainable development might lead to "(...) curtailing and challenging the potential of the CDM (Voigt 2008:17). One issue has been the vague definition and arbitrary understanding of the term sustainable development by the DNAs. The concern is that national governments, i.e., DNAs, will encounter a conflict of interest between the overall desire for foreign investment and the needs of local communities who are affected by project. This is a classic deliberation between the economic and social concern within the term sustainable development. After years of negotiations on how to include sustainable development into the CDM system as a whole, an Adaptation Fund under the Protocol, designed to counter the focus on economic gain, was made operational in early 2009. The fund gets its revenue from a 2 percent “adaptation levy” on the revenues from the sale of CERs. This is the first dedicated tax base of funds from North to the South and will approximately amount to US$300 million in 2012 (Hultman et al. 2009).

Voigt (2008) argues for the construction of a coherent and international understanding of the term sustainable development through climate law and practice. CDM Watch (2009), on the other hand, argues that because monetary value is only given to emission reductions there is a trade-off between the two objectives of the CDM. The NGO also wants a UNFCCC- determined standard for assessing the sustainable development benefits of CDM projects (CDM Watch 2009).

Olsen (2007) reviewed the literature on the CDM's contribution to sustainable development up to 2006. Her main conclusion is, based on 19 studies from a wide review of peer-reviewed articles and other reports, that the CDM has not made a significant contribution to sustainable development. The main critique emerging from the studies is in line with CDM Watch (2009): there is a trade-off between the two objectives in favor of producing low-cost emission reductions at the expense of achieving sustainable development benefits. Olsen turns the critique around and identifies it as the problem of a perfectly functioning market for GHG emission reduction credits. Her question then is what can be done to direct the CDM in a way that it contributes to sustainable development in developing countries.

# 5. Technology transfer in the context of the CDM

The CDM has been hailed as “a key means to boost technology transfer and diffusion” (Dechezleprêtre et al. 2008:1273), an “innovative mechanism that builds a bridge over the “North/South” gap in the Kyoto Scheme” (Voigt 2008 s. 15) and as “[encouraging] sustainable development in the non-Annex B countries [developing countries]” (Wara 2008 s. 1773). Even though one of its main goals is to reduce the costs of abatement in industrialized countries, the hope is that the expensive, but climate-friendly technology will be transferred to developing countries so they can avoid a path of development which includes massive $CO_2$-emissions. Since developing countries do not have to reduce their emissions under the Kyoto Protocol, their way of participating in the agreement is to open up for building low-carbon energy infrastructure, fuel switching projects, afforestation, energy efficiency projects and so forth (Ellis et al. 2007). This will decrease their dependency on fossil fuels, and at the same time steer them towards sustainable development. The promise of investment and technology transfer embedded in the CDM is seen as an important contribution to development in the South. There have been experiences by those working with North-South development that have been overlooked by those working with the CDM. It is important to bring these experiences to the table by looking at technology transfer in connection to the CDM.

In order to explore whether the CDM contributes to technology transfer, it is important to first consider several definitions of technology transfer, which I will do in the following sections. I will also use Kristiansen (1993) and his categorization of technology dimensions in a society, which in chapter 8 will be used to assess the contribution of wind power sites registered as CDM to the area of Jaisalmer. The chapter ends with a rundown of technology transfer in the spirit of ecological modernization.

## 5.1 Defining technology transfer

The term technology transfer is nearly as tricky to define as sustainable development, and it is often blurred with the corresponding terms technology *diffusion* and technology *spillover*. The terms “diffusion” and “transfer” are used in Article 10c of the Protocol, as well as in the definition given in an IPCC special report (2000) on “Methodological and Technical Issues in Technology Transfer.” This special report has played an important role in the further work of developing the CDM. In the IPCC definition, the term “transfer” encompasses both diffusion and cooperation *across and within countries*:

> (…) “the broad set of processes covering the flows of knowledge, experience and equipment amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/educational institutions. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose it and adapt it to local conditions “(ibid: section 1.4).

Several studies (DeCoenick 2007, Seres et al. 2007, Dechlezlepretre 2008) have deemed the IPCC definition as to broad and vague to utilize in an operational way. Neither does the IPCC definition account for the novelty of the technology. After surveying several definitions of the term (Robinson 1988, IPCCC 2000, IEA 2001, Haake 2006, DeConnick et al 2007, Lewis 2007, Seres et al 2007, Brewer 2008, Dechezleprêtre et al 2008), I found there are minute differences in phrasing, but general consensus on what the term should contain. I have chosen to use the definition given by Gill Wilkins in his book “Technology Transfer for renewable energy: Overcoming barriers in developing countries” (2002). It is a simpler definition than the IPCC and one that comprises the full meaning of the word “technology” –and is a definition that specifically focuses on technology transfer from developed to developing countries:

> “Technology transfer can be defined as diffusion and adaption of new technical equipment, practices and know-how between actors (e.g. private sector, government sector, finance institutions, NGOs, research bodies etc.) within a region or from one region to another” (Wilkins 2002: 43).

Even though Wilkins includes novelty of the technology in his definition, this is not a requirement in the CDM. But because several studies to which I referred earlier exclude “old” technology, it might seem that novelty is an important part of technology transfer. In the case of India, the DNA requires that the technology be state-of-the-art. During my fieldwork, I focused on the actor's own perception of technology transfer by asking them questions about practices and know-how, but also questions about whether they knew where the technology they were using came from. In chapter 8 I will analyze their replies according to levels of “technology dimensions” as they are given by Kristiansen (1993).

## 5.2 Technology diffusion

Both the IPCC (2000) and Wilkins (2002) include technology diffusion in their definition, and Article 10c in the Protocol urges Parties to promote diffusion of ESTs. Technology diffusion differs from technology transfer because it seems unintentional. The IPCC defines it as a process of technological change brought about by “(…) dispersed and uncoordinated decisions over time” (IPCC 2000: section 1.4). Diffusion of technology has a lot to do with the spread of technology through geographic areas; it does not include a transferee and a recipient. Technology is treated as a commodity, and the tacit parts of technology, i.e. knowledge, are often overlooked. Still, technology diffusion might follow as the next stage after a technology transfer has occurred and serve as the proof of a successful transfer. The further spread within a society can be classified as diffusion.  Diffusion could thus be decoupled from the origin of the technology, and it does not necessarily concern a technology that is *new* within a given context. That is why I in chapter 8 will apply this definition to see if the CDM has brought about diffusion of wind power technology to Rajasthan.

In judging whether a technology transfer has been successful or not, Wilkins (2002) emphasizes the need to focus on affordability, accessibility, sustainability, relevance and acceptability. For Wilkins, a technology transfer should involve putting technological concepts into practice locally in a sustainable framework so the locals can understand it, use it in a sustainable manner and replicate it, thereby speeding up successful implementation. Local use of technology is a part of Kristiansen's (1993) four dimensions of technology, which I will revisit in section 5.4.

## 5.3 Technology transfer under the UNFCCC and the Kyoto Protocol

Under articles 4.3, 4.4, and 4.5 in the UNFCCC, industrialized countries have a commitment to supply financial resources to developing countries to help them meet their commitments,[21] to adapt to the adverse effects of climate change and to promote the transfer of ESTs to developing countries (UNFCCC 1992, Depledge 2004).

In the literature on technology transfer, technology is understood as something both physical and tacit. It is physical because it is something you *need* to be able *to do* a certain activity. If you wish to get energy from wind you will need a wind energy generator. But the tacit part is the knowledge of how to work that wind energy generator so it produces the desired results. The transfer of technology could include both the physical and tacit components, but this is not always the case. What is important is that technology transfer is something intentional; it involves a recipient and a transferee. In the context of the CDM, the transfer is international.

Technology transfer has been an issue in the international arena longer than climate change. Joanna Depledge labels the talks on technology transfer between the North and the South as a “(…) dialogue of the deaf” (2004: 44). The conflict stems from developed countries claiming they cannot transfer technology to

[21] The commitments of developing countries are stated in article 12 of the UNFCCC. They are supposed to make a national inventory of GHG emissions by sources and sinks (any process, activity or mechanism which removes a greenhouse gas. Forests, soil and the ocean are sinks which have the temporary ability to soak up $CO_2$ and store it). Developing countries are also to describe what steps they are taking to implement the Convention and in general what they are doing to achieve sustainable development.

developing countries because technology is invented and owned by the private sector and from developing countries' domestic barriers to the import and deployment of transferred technology. On the other hand, developing countries accuse the developed countries of not making a bigger effort to facilitate for technology transfer (ibid.). Despite the contentious negotiations around technology transfer in Rio, the principle was reaffirmed in the Kyoto Protocol under article 10c (italics added):

> "All Parties, taking into account their common but differentiated responsibilities (…) without introducing any new commitments for Parties not included in Annex I (…) shall:
>
> Cooperate in the promotion of effective modalities for *the development, application and diffusion* of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries, including the formulation of policies and programmes for the effective transfer of environmentally sound technologies that are publicly owned or in the public domain and the creation of an enabling environment for the private sector, to promote and enhance the transfer of, and access to, environmentally sound technologies" (UNFCCC 1998).

The transfer of ESTs from developed countries to developing countries is considered an important way of mitigating the largest share of future GHG emissions. There is no doubt that efforts toward lifting the majority of the world's population out of poverty will require enormous amounts of energy and investments in energy infrastructure. The reason for transferring ESTs is the hope that developing countries will use less carbon-intensive technology for lifting their population out of poverty. This is known as leapfrogging, as defined in chapter 4. The UNFCCC secretariat estimates that 70 percent of GHG mitigation potential is in the developing parts of the world (UNFCCC 2009). Leapfrogging can be done in several ways;

- Setting up subsidiaries of an international company, either wholly owned by the mother corporation or as a joint venture.
- Giving licences with the promise of transferring know-how, managerial expertise or technical services.
- Actually buying the technology to study it and acquire it.
- Transferring workers with specialized skills (Kaplinsky 1990).

## 5.4 The four dimensions of technology

Kristiansen (1993) studied several technology transfers from Norway to countries in Africa and Latin-America. He assessed the degree of knowledge transfer through observation and interviews of the participants in the technology transfer projects. His assessment will be useful for my case study of the three wind power companies in chapter 8. In his study he presents how technology can be characterized in a sector; there are two dimensions: modernity and depth. The former looks at development and continuous innovation and improvement of technology, while the latter is divided into four layers and is used to determine the level of knowledge and capacity in the sector. These four layers will be used further on in this thesis to assess the different wind power companies' technology capacity. They are represented in figure 3 which is based on Kristiansen (1993).

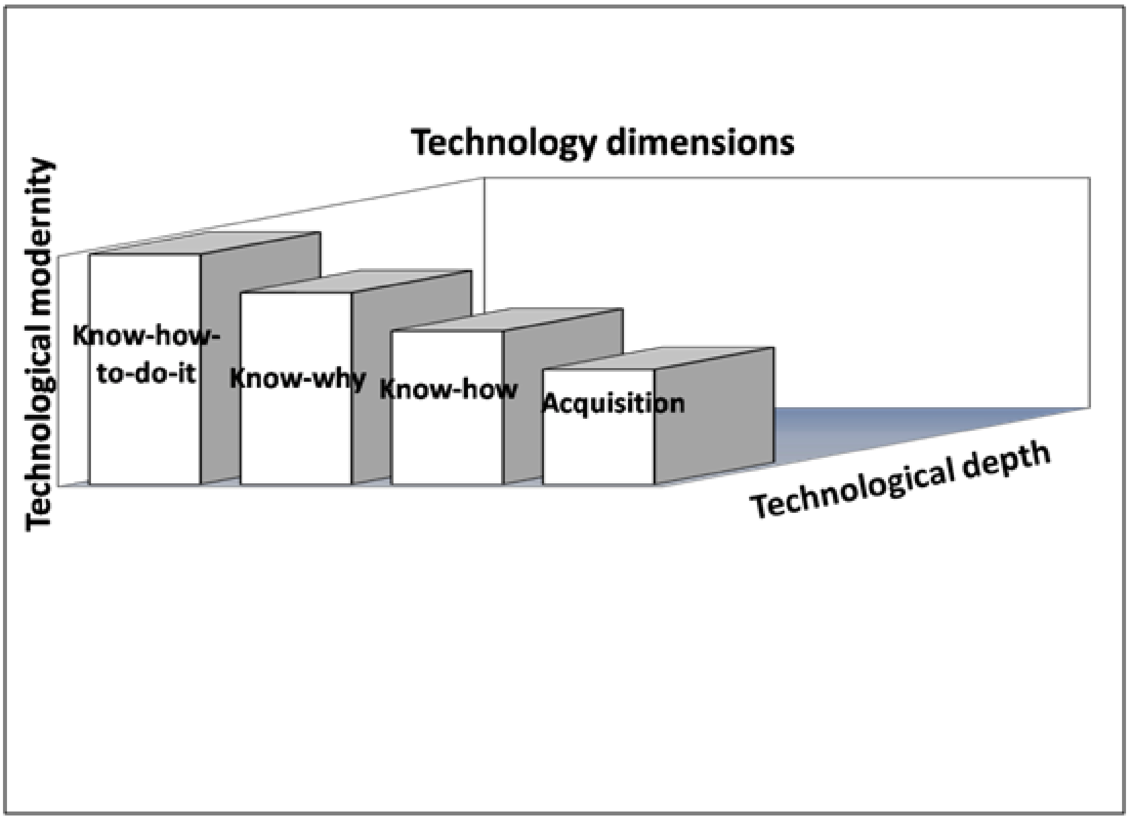


Figure 3. Technology dimensions in a sector

The understanding of the modernity dimension is based on technological development in industrialized countries. In these countries there is a constant evolution of technology driven by competition and profit demands with the result that older technology is replaced by new technology. This leads to an overall growth in productivity and improved competitive conditions for the sector in question (Kristiansen 1993).

The CDM is looked upon as a tool for replacing the old with the new (and more environmentally sound) in developing countries (UNFCCC 2009). It is worth noting that Jänicke and Jacob (2005) define modernization in the same way as Kristiansen.

In figure 3, the depth dimension is divided in four stages, which ascend from right to left. When a sector moves up the modernity axis, it also expands its "depth" i.e., knowledge and capacity. Acquisition is the first and shallowest stage; here the sector has just gotten access to a new type of technology (Kristiansen 1993) or it has introduced an innovation developed within the sector (Jänicke and Jacob 2005). In the context of a developing country, Kristiansen characterizes the local knowledge and capacity in the acquisition stage as superficial and not sufficient enough to start up production led and understood by the local labor resources. The pertinent example is a transnational company which sets up a factory in a developing country where the production equipment and organizational system is transferred entirely. The production itself is dependent on foreign experts from the mother corporation. Kristiansen does not see this as a full-value technology transfer.

The next stage, and a deeper step up the technological modernity axis, is know-how. This is where the sector moves beyond blueprints, manuals, and hardware – i.e., explicit knowledge – and starts gaining tacit knowledge. By this time in the developing country, the sector should have gained enough insight into the technology to know how the production is supposed to flow. The workers should be able to do the routines established to keep production going, and also know how to perform regular maintenance tasks. It is impossible to guarantee that the transfer of tacit knowledge will happen and it is equally difficult to verify that it has happened. But by participating in installation, operation and maintenance of the hardware there is a possibility that the workers will gain know-how.

The third tier is know-why and the term indicates that the recipient of technology possesses knowledge about the underlying conditions for production. It is crucial that the recipient, here the single firm, is given enough training to fully understand how the technical equipment functions. The goal is to move beyond know-how on to what to do when the equipment functions properly, and to a level where the recipient can make repairs, adjustments and improvements on the equipment, as well as on the organizational and administrative level of the production process. The know-why stage entails a larger share of production stimulating local economic growth. In addition, the degree of dependency on external technology suppliers is less than in the former stage.

The fourth and final stage is know-how-to-do-it. At this stage the sector has gained a combination of expertise and range so it can deliver important technical components and non-routine services to the production process. The knowledge base in the sector is wide and deep enough so that the country itself can draw advantages from linkages formed around an industrial sector. This means that the production in, for example, the wind turbine sector can advance because there is a demand for turbines in the wind power sector. The demand can give the wind turbine sector a competitive advantage locally, as well as internationally. Kristiansen (1993) states this as the primary goal for industrial development in developing countries: nurturing some sectors so they can become players on the international market and contribute to the export profits of the country. Nevertheless, it is not given that technology transfer will always lead to the know-how-to-do-it stage, according to Kristiansen. In some cases it just might be the transferee’s intention to provide acquisition type of technology and training, and the same might be true for the recipient.

This is referred to as technology control. During the Cold War it was a well known fact that Western countries were skeptical of transferring technology to developing countries that were in favor of Communism. The West feared that this technology would be deployed to the USSR and used against them (Chatterji 1990). After the Cold War these restrictions disappeared, and businesses today are motivated by expectations of profits in a truly global market. Even so, developed country firms want to keep control over the use of the transferred technology. Technology control is often defended on the grounds that hardware and knowledge will be sold by the recipient firm to other businesses and markets. Controlling the spread of technology in developing countries is often a part of the negotiations between senders of technology and recipients. Firms in developing countries and their governments, i.e., the recipients, want to secure the right to use transferred technology on a larger basis as a part of a modernization strategy (Aasen et al. 1990). Recently, technology control has also been linked to intellectual property rights (IPRs)[22]. Industrialized countries patent technology in order to protect their innovations, while developing countries regard IPRs as a barrier to technology transfer.

## 5.5 Technology transfer in the spirit of ecological modernization

There are still barriers to full deployment of environmentally sound technology; the UNFCCC states that they range from legal, regulatory, institutional, financial, lack of technical capacity to social barriers (UNFCCC 2009). Ecological modernization, as defined by Jänicke and Jacob, is clear on the need of government policy to help ESTs overcome market barriers, as governments can lend support for developing and support ESTs that are not immediately profitable.  But ESTs also count on "(…) a broad spectrum of transfer mechanisms beyond the market which (...) help their diffusion on the world

[22] IPRs protect human innovation and intellectual effort. IPRs include patents, plant breeder rights, trade secrets, trademarks and copyrights. Patents are specific rights granted by governments to inventors which enable the right holder - the inventor - to exclude third parties from the protected invention in the countries where these are registered. From an economic perspective, IPR regimes are premised on the belief that prospective financial returns in fact drive private creators of intellectual property. Another way of looking at this is that a lack of IPR protection will enable everyone to access a technology, but this comes at a dynamic cost of deterring further innovation, and thus may stifle (positive) development. These interests may differ between developed and developing countries (IPCC 2000).

market" (Jänicke and Jacob 2005: 178). In order to establish new markets for environmentally innovative technology, the authors list three ways of building appropriate political strategies. These are:

1. Improvement of the infrastructure to supply environmental innovations.
2. The safeguarding of demand by means of environmental policy.
3. The utilization of transfer mechanism to speed up diffusion of policy innovations into other countries (ibid.).

"Green" international markets rely on strong national pioneers in environmental policy. National pioneers, according to Jänicke and Jacob, are countries which are innovators or early adapters of environmental policy. These innovative measures then diffuse to other countries. Examples of these national pioneers are: USA (air pollution regulation), Denmark (wind power policy), Germany (renewable energy policy and carbon tax) and Spain (wind power policy).
In addition to being a vehicle for technology transfer, the CDM also plays a role in diffusing internationally approved policy on climate change. Developed countries are mandated to take the lead in abating emissions, but the CDM gives developing countries a chance to participate when they host CDM projects. Participation of developing countries is vital for achieving global emission reductions, and thus fulfilling the ultimate objective of the UNFCCC and the Kyoto Protocol (Ellis et al. 2007). Ideally the CDM is supposed to be a partnership in which industrialized countries "(…) work with developing countries to further sustainable development and the overall objectives of the Climate Convention" (IPCC 2000: section 3.6). Participants in developing countries include private and public sectors, and in the next chapter I will use fieldwork data to analyze how private sector participation in the CDM and national policies on renewable energy have affected the Indian wind power sector.

# 6. CDM and Indian renewable energy policies

The Indian wind power sector is characterized by a mature and well established industry which is a global market player (WWEA 2008). The sector has been developing since the 1980s, and in section 6.1 of this chapter I will recap its development. I will also focus on the CDM's contribution to national wind power policies for the development of the wind power sector in section 6.2. Indian project developers saw the CDM as an advantage early on and have been at the forefront of entering their projects into the CDM-cycle since 2005. It was only in 2008 that China surpassed India as the country hosting most wind power CDM projects. Today, Indian wind power projects make up 7 percent of all projects in the entire CDM Pipeline[23], while the Chinese wind power projects have an 8, 7 percent share.

The CDM can bring in financial resources to sustain a development trajectory, but the advantages of participation for non-Annex I countries are also positive effects on reducing their GHG emissions (Zhang 2004, Ellis et al. 2007, Wang and Firestone 2010). Because the CDM is a market-based mechanism, participation equals attraction of both private and public sector investors. In addition, investing in CDM projects has an influence on the overall participation of developing countries in the climate change regime. Developing countries have no obligations to reduce their emissions under the Kyoto Protocol, but under the UNFCCC and the leadership paradigm it established, there is hope that once industrialized countries have curbed their emission, developing countries will follow their lead. In section 6.3, I will explain how investors and project developers built their knowledge on the CDM by attending the CDM Bazaar 2009. The section is rounded off with a description of how the CDM is dealt with within the three wind power companies I interviewed during my fieldwork. The

[23] 351 Indian wind power projects out of a total 4926 CDM Projects in February 2010 (UNEP Risoe CDM Pipeline February 2010).

main focus is on why they opted for registering their wind power projects as CDM.

## 6.1 Indian Wind

In the wake of the two oil crises during the 1970s that caused the price of crude oil to soar, the government of India, as a major importer of oil, established a goal of energy self-sufficiency. A Commission for Additional Sources of Energy was established in the Department of Science & Technology in 1981. This was the major driver for new national policies and programmes on renewable energy, and for intensifying research and development (R&D). A year later, India established the Department of non-Conventional Energy Sources, becoming the first country to create an agency dedicated to renewable energy. Today it is known as Ministry of New and Renewable Energy (MNRE) and manages several programmes on renewable energy for both urban and rural areas, as well as focussing on R&D and technological development for renewable energy (Ravidranath et al. 2000, MNRE 2009a, Purohit and Purohit 2009).

The National Programme for Wind Energy was initiated in 1983-1984 by the MNRE, and had several components: e.g., wind resource assessment, R&D activities, financial support, and national targets on installation. Indian wind resources fall in the category of a low-wind regime, where the majority of sites have wind-power speeds at 5, 6 - 6 m/s (C-Wet 2009a), while the wind resources within the country are grouped from low to high. Rajasthan falls into the low category with wind speeds at 5, 6 - 6 m/s, while Jaisalmer has better conditions with medium wind speeds at 6 - 6, 4 m/s. In the United States, which is generally regarded as the country with the largest wind power potential, the majority of sites have wind speeds from 6-8.8 m/s (AWEA 2006).The development of the sector is summarized in Table 1. The summary draws on a similar account by Ravindranath, et al. (2000), with the same demarcation of technology development stages. I have extended the time period of the commercialization phase until 2008.

Table 1. Development of the Indian wind sector 1983-2008

| **Technology and phases** | **Policy** | **Objectives** | **Impact** |
|---|---|---|---|
| *Research and development*<br><br>(1983-1985) | • Wind resources survey<br>• Financial support to import critical wind energy generator (WEG) components for assembly in India<br>• Technology assessment and adaptation to suit Indian conditions. | • To publish the Wind Energy Data Handbook, and identify potential sites for private sector participation.<br>• Government funded indigenization of technology.<br>• Estimation of wind power potential. | • Potential sites for installation identified and Wind Energy Data Handbook published in 1983.<br>• Estimated potential: 20 000 MW.<br>• Research for a new generation of WEGs<br>• Wind resource reassessment programme launched to improve reliability of data. |
| *Demonstration*<br><br>(1985-1992) | • Installation of turbines by the state nodal agencies.<br>• Monitoring and evaluation of performance<br>• Establishment of the Indian Renewable Energy Development Agency (IREDA) in 1987, a public financial institution to promote, develop and extend financial assistance for renewable energy (REN) and EE/Conservation Projects. | • Show technical feasibility to potential market players<br>• To create awareness about the technology. | • Demonstration projects established in eight states, 23 locations.<br>• Turbines of different types and designs installed (55-10 kW to 400-600 kW). Identification of technical problems, such as lack of compatibility, machine stability and grid problems.<br>• Established production base for assembly of components<br>• Cost estimation and the economic analysis of power generation; capital investment for wind farms set at Rs. 35-40 million/MW and the cost of generation estimated at Rs. 2,25-2,75/kWh |
| *Large-scale dissemination* | • Policy on wheeling, banking and buy-back developed in the different states. | • To promote greater use of renewables and to create a market. | • Installed capacity in 1993 was 42 MW.<br>• Incentives included: 5-year tax holiday, 100 percent accelerated depreciation in the first year, concessional loans from IREDA. |

| | | | |
|---|---|---|---|
| (1992-1995) | • Fiscal and financial incentives introduced. | | • Later on the policy of accelerated depreciation was set down to 80 percent.<br>• Infusion of externally funded projects; the Indian Renewable Energy Resources Project was implemented through IREDA, but funded by the World Bank and GEF. It had a wind component of 78 million dollars for installing 75 MW. There was also a line credit of 105 million dollars for a capacity addition of 105 MW. The ADB also provided a line credit for wind power projects.<br>• Several financial institutions such as the IFCI, IDBI and ICICI were liberalized to provide financing at market rates.<br>• The Eight Five-year Plan set a target of 500 MW for private sector involvement.<br>• The increase in installed capacity grew about 18 times in three years, from 42 MW in 1993 to 733 MW at the end of 1996.<br>• India ranked fourth in the total installed capacity in the world. |
| *Commercialization*<br><br>(1995-2008) | • Continued support for research and development for new generation of WEGs.<br>• Full implementation of fiscal and financial incentives<br>• Electricity Act passed in 2003.<br>• CDM came into operation in 2005 | • To facilitate market forces.<br>• To promote private sector infrastructure.<br>• State electricity boards have to specify minimum percentages of power to be procured from renewable energy.<br>• Transfer of REN technology to and insuring sustainable development in developing countries | • Establishment of C-Wet, an R&D institution under MNRE.<br>• Interest rates for wind energy loans were moved to normal market rates from 1995.<br>• From 1997 and onwards over 90 percent of all installations are done by the private sector.<br>• The capital cost per MW increased from Rs. 35-40 to Rs. 40-45 million.<br>• From 1995 to 1998 more than 70 percent of indigenization was achieved. This was for machines up to 500 kW.<br>• Two installation booms; 25 percent annual growth from 1994-1999, and 40 percent annual growth from 2004 to 2007.<br>• The first one followed after large-scale privatization of the sector, while the second boom came after Electricity Act 2003 where the state utilities had to set procurement targets for renewable energy.<br>• India has consistently been one of the front runner countries for CDM-projects. Wind has been the biggest CDM-investment.<br>• In 2008, India was ranked as number five in the world on installed wind energy capacity. |

**Sources:** Rajsekhar et al (1999), Ravidranath et al (2000), Gosh et al (2002), Singh (2008), GWEC (2009), Purohit & Purohit (2009), UNEP Risoe CDM Pipeline

The government is still very much involved in the sector by providing financial assistance when a company sets out to establish renewable energy projects. In addition to loans from IREDA, those who wish to invest in a WEG can expect to be: exempted from income tax for 10 years, get 80 percent accelerated depreciation (tax write-off) for wind project capital costs in the first year of operation and be exempted from sales tax and excise duty (Purohit and Michaelowa 2007). These incentives, coupled with a liberalization which allowed for private sector participation in 1992 and institutional agreements created a demand "pull" for wind energy in the private sector, this can be seen in figure 4 (Gosh et al. 2002).

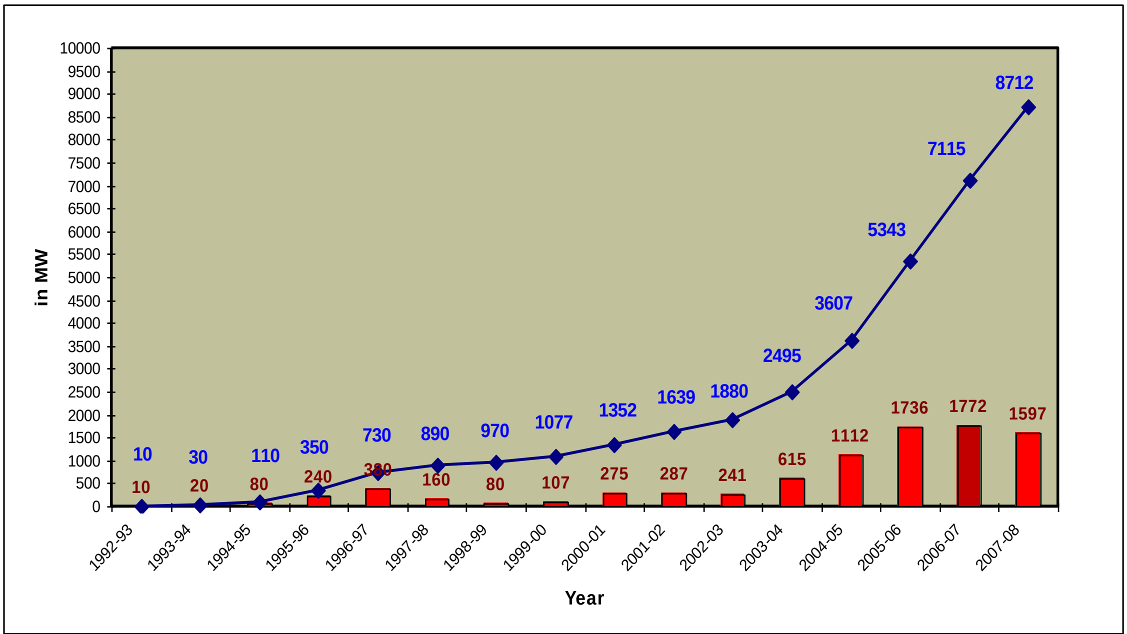


Figure 4. Yearly total installations of wind power, and yearly growth in MW
Source: IWTMA 2008

At the state level, there are individual policies mandated by state governments. Several states have chosen to implement their own fiscal and financial incentives for renewable energy generation. I will come back to the specific details for Rajasthan in the next chapter.

The government, i.e., the Planning Commission, sets targets for installation of renewable energies. In the latest five-year plan, the Eleventh Plan (2007-2012), the target for 2012 is that 14 gigawatts (14 000 megawatts or 10 percent) of the total power generation come from renewables[24]. Out of this, wind power would be the biggest contributor, with 10.5 GW installed by the end of 2012 (Planning Commission 2008). The hope is that renewable energies will make up about 4 to 5 percent of total electricity generation by then (Purohit & Purohit 2009). The total installed capacity of the renewable energy sector is 14 914 MW as of January 31, 2009 (MNRE 2009b). The wind sector has led the way in installations and has achieved twice its set target during the Tenth Five Year Plan[25]. In the Indian energy scenario, renewable energy makes up 7, 7 percent of the total installed power (MoP 2009).

In 2008, 95 percent of the total installed capacity for wind power consisted of private-sector projects, while the rest were demonstration projects (Mabel & Fernandez 2008). The installed capacity grew 25 percent annually from 1994 to 1999, while the growth rate exploded to approximately 30 percent annually from 2004 to 2007 (Ravindranath et al. 2000, Lewis 2007).

The companies who invest in a WEG come from a wide array of sectors: metals and mining, textiles, consumer goods, automobile, finance and process industries (Singh 2008), but also wealthy individuals such as several Bollywood-stars (Suzlon engineer interview). The Suzlon engineer explained who his customers are and why they choose to invest in WEGs:

> “They are the industrialists. If they have any profit from the industry side, 3 crore, 4 crore, they invest them in the wind mills. The first benefit is 80 percent free from tax, for the ten years and then for the 20 years. The main benefit is for the customer.”[26]

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[24] 14 GW is to come from grid-interactive power, i.e., renewable energy that is distributed through a regional electrical grid, while 1 MW is to come from decentralized renewable energy, such as bio power, solar power, stand-alone WEGs and small hydro power (Planning Commission 2008). In this thesis I’ll only refer to the target for grid-interactive power generation because that was the focus of my fieldwork and constitutes the largest section of the REN-sector in India.

[25] The target for RENs during 2002-2007 was 3075 MW, while actual achievement was 6711 MW. Out of this, wind power installations amounted to 5414 MW, which is 3.61 times its target.

[26] In India the units crore and lakh are used to denote values over 1 million. 1 crore equals 10 million, while 10 lakhs equals 1 million. 100 lahks equals 1 crore.

### 6.1.1 Electricity Act

The last growth period from the year 2004, depicted in figure 4, was caused by a new law passed by the central government called Electricity Act 2003 (Lewis 2007, Viapradas and Kumar 2008, Purohit and Purohit 2009). Prior to the passage of the Electricity Act, the World Bank initiated and supported reforms to unbundle the state electricity boards (SEBs) in several states including Rajasthan. The entire Indian electricity sector went through a restructuring with the implementation of the Electricity Act in 2003:

- The vertically integrated electricity state supply utilities were unbundled and State Regulatory Commissions (SERCs) were set up and left in charge of deciding on tariffs.
- The transmission system was opened up and consumers can now purchase electricity from any producer.
- The SERCs are also required to set a renewable portfolio standard: a minimum percentage of power to be procured from renewable energy sources.

Because the Indian electricity sector is in continuous growth and is supported by adequate policies, renewables are a viable option to meet the demand. This was recognized early on by national and international agencies. The renewables sector in India was pegged as having the largest GHG mitigation potential (approximately 154 $MtCO_{2eq}$) under the CDM (Sathaye et al. 1999, Gonsalves 2006). At the same time, and before the CDM became operational in 2005, the efforts for building capacity among officials and projects developers on the CDM in India were increased resulting in a rush of PDD submissions to the national DNA. From 2005 to 2006 there was nearly a nine-fold increase of host country approved projects; from 38 projects to 364 in one year (Sirohi 2007).

## 6.2 Indian wind power and CDM

With such favorable policies for wind power development already present in India, what has been the role of the CDM in expanding the sector? From 2005 to 2008 the annual new installation rate of wind power experienced a 14-percent decline (Figure 4), and that's discounting the global financial crisis from mid-2008 (IWTMA 2008). Interestingly, this was also the period where registration of new CDM projects soared in India.

One motivational factor behind the CDM was to save on abatement costs in Annex I-countries, but also to contribute to sustainable development in developing countries. The hope lies in increasing foreign direct investment (FDI) in projects which reduce GHG emissions through the use of climate friendly technology. At the same time, expansion of the CDM market and inclusion of developing countries in the overall market system is based on investors who are willing to put up money for GHG emission abatement projects.

In terms of investment flows, India's 716[27] CDM projects totalled an investment of $13 billion in 2007. 85 percent of the total investment (US$11.3 billion) comes from Indian project investors themselves because India mostly hosts unilateral projects (Seres et al. 2007). This means that the project originates entirely within the host country. The whole process of finding investors for, developing and implementing a wind power farm is carried by the host-country project developer, such as Enercon, Suzlon or RRB Energy.  I will come back to the implications of unilateralism for technology in the next chapter. Unilateralism in Indian CDM projects makes it even more important to sell CERs and generate foreign financial flows. It is estimated that CER revenue can raise a project's internal rate of revenue[28] (IRR) from 0.5 percent to 3 percent (Robins et al. 2008).

The Indian Ministry of Environment and Forests has high hopes for CER sales. In a press release they state that if all of the DNA-approved projects are

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27 In their analysis, Seres et al. included all projects approved by the Indian DNA until September 2007; by March 2009 India had 398 projects registered by the CDM Executive Board, while 858 projects were approved by the DNA and waiting for approval from the Executive Board.

28 The internal rate of return can be thought of as an estimated rate of growth a project is expected to generate. If the IRR exceeds the cost of financing the project, then it is considered viable (Investopedia.com and InvestorWords.com).

registered by the EB, it will represent an overall inflow of US $5, 73 billion by the year 2012 (CDM India a.). This is quite optimistic, as an HSBC study estimated that the Indian CDM market would generate inflows of US $ 3, 94 billion by 2012 (Robins et al 2008). The authors of the HSBC-study set the price of CERs at €20 per tonne, which is also optimistic considering the crash in the carbon market as a result of the economic crisis. From September to November 2008 the prices fell from €25 to €15, and the estimated future growth in CER prices for 2009 was adjusted down by 25 percent (Fitter 2008). Even though India has captured a large share of the global carbon market, there are several uncertainties about the market itself which have an influence on the projected prices. The uncertainties have been related to what happens after 2012, transaction costs and risks with meeting the additionality criteria.

Viapradas, the consultant from Senergy Global, said that CDM is considered a risk for investors because they did not have guarantees of gaining CERs and selling them afterwards (Viapradas interview). The paradox of the CDM additionality criteria was explained by Subramanian, secretary general of InWEA. In order to achieve registration and get the CER benefits the developers of the Indian wind power project have to prove that the project would not be viable without CER revenue. When they are applying for loans, on the other hand, they have to prove that the project is viable. The bank will also ask for guarantees of CER sales (Subramanian interview). The Group President of Corporate Finance and Development Banking at YES Bank, Somak Ghosh, states the same in an article about financing wind power projects in India:

> “Cash flows from the sale of Certified Emission Reductions (CERs) can be used as an additional security to support debt but are not likely to be the basis for borrowing. (...) Hence, project lenders typically look for repayment capacity, excluding CER revenue, while doing an analysis” (Gosh 2008:13).

His statement might be interpreted to mean that Indian project developers look for other sources of revenue. Indian CER holders are restrictive about trading, according to a study by the Federation of Indian Chambers of Commerce & Industry (FICCI) (GTZ 2008). In 2008, less than 30 percent of CERs from 356 registered projects had been sold or contracted. CER trade was even smaller the year before, when only ten percent of the total volume of Indian CERs was sold to foreign buyers. Can this mean that Indian policies provide enough financial inflow so that Indian project developers can afford to wait for better CER prices? Putting a price on carbon and encouraging trade is in line with the ideas of ecological modernization. The mechanisms of the CDM and emissions trading are supposed to internalize the structural design flaw of a society and create economic opportunities for market actors (Barry 2005). If market actors withhold CERs because national policies present larger economic opportunities, this might imply that the ideas of ecological modernization embedded in the CDM are not fully transferable across countries.

Viapradas is convinced that the only reason for the expansion of the Indian wind power sector is the tax incentives, and that these provide investors with larger revenue than the CDM (Viapradas interview). Subramanian and Viapradas characterized CDM revenue as just “cream on the pudding” and “an add-on.” They considered it superfluous because not only does a wind power plant get a preferential tariff for selling power to the states, investors also take advantage of accelerated depreciation and tax holidays (Subramanian interview and Viapradas interview).

Since the numbers show that new installations were on a decline at the same time that CDM registration boomed, there might be support for their opinion. In a special edition of the industry publication InWind Chronicle, several industry insiders offer further explanation for why new wind power installations are declining:

- there are less good wind sites available,
- state policies are inconsistent among and within states,
- there are problems with land acquisition and grid availability (Viapradas and Kumar 2008, Makhija 2008, Singh 2008).

The CDM cannot be of help here since it is designed to generate revenue only after all these hurdles are overcome. Subramanian’s impression was that investors and project developers were excited about the CDM in the beginning because of a promise of increased revenue:

> “Now the prices have come down. It is not worth taking all the effort. I mean, the amount of money you must spend to prepare a CDM project, some people say we do not want this. It’s a torturous process.”

According to him, the beginning of the CDM in India bore traces of being captured by established companies who could afford the high costs of registration, while now this trend was less prominent

Ultimately, the CDM has had a marginal effect on the expansion of the wind power sector. It is the policies of the Indian government which have led the sector to where it is today, and will push the sector forward. The government has already initiated a generation-based incentive scheme to attract investors who are not able to take advantage of tax depreciation. There are plans of implementing Renewable Energy Certificates (RECs) to encourage further installation and trade in renewable electricity between states (InWind Chronicle 2008a, InWind Chronicle 2008b). In Viapradas’s view, the national policies and state tariffs have made CDM registration of wind power projects more difficult because the EB only takes the financial criteria into consideration. His conclusion was that India should not be punished for being a pioneer in implementing policies to develop its own renewable energy sector. Indian policies were in place long before there was talk about climate change and the Kyoto Protocol (Viapradas interview) and as a result the CDM has been adapted to suit Indian policy conditions (MNRE-official interview).

## 6.3 Participating in the CDM

During April 28 and 29 of 2009, New Delhi's Taj Mahal Hotel hosted a capacity building conference entitled Carbon Bazaar 2009. It was organized by the Indian Ministry of Environment and Forests and its German counterpart, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety. The goal of the conference was to connect future and present project developers (Indian) with prospective investors and buyers of CERs (German). At the same time project proponents were made aware of the recent developments in the CDM system. There were several lectures on the new buzzword of the CDM – programmatic CDM – and how to finance renewable energy projects through the CDM. The participants, numbering around 150, were industry professionals, NGO representatives, state and national bureaucrats, and small-scale project developers looking for financing. During the lectures, the German speakers emphasized the huge potential for GHG mitigation in India while the Indian speakers concentrated on how to fulfill the additionality criteria. The structure of the conference and the lectures was such that most of the investors were Germans or came from international banks based in India. The investors were of the opinion that individual projects had to be large to generate large volumes of CERs, while the developers were interested in programmatic CDM because it allows for coupling of several small-scale project spread over multiple geographic regions.

This was the first ever CDM Bazaar organized in India, and the focus was on small and medium-sized businesses with GHG-mitigation potential. That might explain the large turnout by small-scale project developers. Even so, the Bazaar was an important way of including project developers from the smaller firms. Subramanian believes that large companies were moving away from CDM participation. If so, the CDM Bazaar might have been a catalyst for broadening participation and improving knowledge among project developers who cannot take advantage of national policy incentives for developing renewable energy projects.

## 6.4 All-in-one solution for investors

The Indian wind project developers recognized that there was a potential in the CDM to earn extra revenue early on, as wind power has captured a large share of the Indian CDM market. The investment model of Indian wind power projects might provide some insight into how this happened.

Manufacturers of WEGs offer investors an integrated solution: facilitation of financing, micrositing of the project, commission and construction and operation and maintenance during the lifespan of a WEG. All three companies I interviewed follow this model. They also guarantee minimum generation of power, in other words the investor is guaranteed a certain amount of income from power sales. Originally, this was done to build confidence in the investor community and prove that wind energy is a viable option (Singh 2008), but now this is seen as a constraint on further progress (ibid., MNRE- official interview, Subramanian interview).

Purohit and Michaelowa (2007) carried out a study of 20 Indian wind power projects and found that the argument of high investment costs used in 14 projects in the CDM cycle were in most cases not convincing. This is because high investment costs are earned in by tax depreciation and higher tariffs provided by national and state government. Still, the authors conclude that the CDM could help India speed up installations of wind power so the sector reaches its maximum potential of 45 GW.[29] However, this can only be achieved if supportive policies are introduced. The authors do not mention what these policies might be.

The business model of providing all solutions to investors was also transferred to the CDM benefits. The CDM was perceived as attractive by the large WEG manufacturers because it might improve the IRR, and therefore be used as an argument for selling more WEGs. Suzlon is the largest wind-power manufacturer in India, and has also captured a large share of the CDM market. Early on they established a consultant company, Senergy Global, which specializes in the CDM. They were consultants for India’s first wind energy project to be registered by the EB (Senergy Global 2007) and they rank 17th on the global top 20 consultant’s list, with 59 registered projects (UNEP Risoe CDM Pipeline June 2009). Senergy Global facilitates CDM wind power projects and is at the same

[29] See section 7.4 for wind power statistics in India.

time a sales outlet for Suzlon. Unlike the other companies, they have an employee in Jaisalmer who is dedicated solely to managing the CDM projects in Rajasthan. This is the Suzlon engineer I interviewed.[30] According to the engineer, 70 customers have applied for CDM status, while between five and ten customers have already sold their CERs to the European market. According to him, the company has a CDM expert in Jaisalmer because it’s better to be close to the customers. His view on why customers invest in the CDM is:

> “The other benefit is the CDM benefit for the customer. [First part of recording unclear] we just sell the CER to the European company, last year the customer was not aware of that; what is the CDM. Then we just help him... What is the CDM, then we just help him. Our marketing department helps him to what is the CDM, what is the benefit. Then the customer gives the repetitive order to me. The main thing I just want is repetitive order from the customer.”

His quote indicates that those who wish to invest in WEGs are also given the option to invest in the CDM. This means that the CDM becomes a part of the overall investment cost of a wind-power project, and that the company (in this case Suzlon) handles all aspects of the CDM project cycle. The investor, often an industrialist, is not familiarized with the CDM system in this way. He is only a receiver of CERs, while the company can charge a consultancy fee for the CDM process.

RRB Energy’s experience as a small player in the CDM market compelled them to evolve and offer the same model as Enercon and Suzlon. That is why they too have added a CDM expert to their staff at their main office in Tamil Nadu. The company has two sites around Jaisalmer which are now in the validation stage of the CDM cycle. For the Akal site, it was the customer Rajasthan Renewable Energy Corporation (RREC), who applied for CDM status. They hired external consultants to take care of the registration process. When asked if the CDM has helped build capacity of the state agencies and investors in the wind energy sector, the RREC-official replied: “Private investors generally approach to the

[30] Enercon and RRB Energy do not have employees who work exclusively with CDM projects in Jaisalmer. Enercon has a CDM department based in Mumbai who follows the same approach as Suzlon. RRB Energy has only recently added an employee with CDM competence to the marketing department at their headquarters.

developer of Wind farm/supplier of WEG for installation of Wind machine according to their financial capacity" (RREC-official e-mail correspondence). He also replied with an unequivocal "Yes" to the question of whether wind power projects established in his state could have happened without CDM, suggesting they are non-additional. As Subramanian and the MNRE-official tell it, there are virtually no customers who base their decision to invest in wind energy because they can get the CDM benefits. This indicates that Indian wind power projects registered as CDM are not additional. The reason why CDM has a stronghold in the Indian wind power sector can be explained by the all-in-one model wind-power manufacturers use to secure investment.

## 6.5 Summary

With the National Program for Wind Energy, India introduced policies that facilitated the growth of the wind power sector. These policies provided wind-power manufacturers and investors with a range of financial incentives. The program was coupled with a liberalization of the power sector permitting private sector participation, and in the mid-1990s there was a demand "pull" for wind energy. Further expansion of wind energy in India was aided by a restructuring of the power sector with the passing of Electricity Act 2003.

Indian wind-power manufacturers saw the CDM as a way of increasing their revenue and securing further wind turbine sales. Today, Indian wind-power projects make up seven percent of all projects in the entire CDM Pipeline. However, from 2005 to 2008 the annual new installation rate of wind power experienced a 14 percent decline. Industry experts attribute this to inadequate state and national policies, land availability and acquisition and a decline of high regime wind sites. In order to build confidence in the investor community, wind manufacturers offered all-in-one solutions. This allowed the investor to reap the financial benefits offered by national and state policies. This attitude was also transferred to the CDM, and my fieldwork shows that the CDM has become a routine aspect of the investment deal, rather than a vital component.

The all-in-one model suggests that a majority of Indian wind power projects are non-additional; they would have been realized even without CER revenue. The Indian wind power sector has managed to attract investors on the basis of national and state renewable energy policies, while the CDM has been adapted to fit into Indian policy conditions.

# 7. Technology transfer in the wind power sector

Wind power has been a focal area for the Indian government since the 1980s. Wind turbine manufacturers were encouraged to strike joint venture deals with foreign companies in order to create a manufacturing base in India. These agreements have resulted in technology transfer where not only hardware, but also "... practices and know-how" was transferred (Wilkins 2002:43). Although there is no clear mandate to transfer technology through the CDM, it does have an objective of promoting sustainable development and investments in developing countries. This was interpreted as a way to boost technology transfer and diffusion between North and South (Seres et al. 2007, Dechezleprêtre et al. 2008, Voigt 2008). There is also a provision in Article 10c of the Kyoto Protocol which urges Parties to the UNFCCC to promote technology transfer of ESTs. Ecological modernization views the process of modernization as innovation and diffusion of ESTs, and sustainable development encourages development of technology to enhance the carrying capacity of a resource base. The results should lead to a win-win situation for all those involved. Technology transfer is an area where ecological modernization and sustainable development are in agreement.

Section 7.1 will focus on the transfer of wind power technology to India through the CDM from lead markets in Europe and North America. The implications of unilateral CDM projects and how Enercon, RRB Energy and Suzlon acquired their WEG technology are discussed in section 7.2. Section 7.3 assesses the degree of knowledge transfer according to Kristiansen's (1993) dimensions of technology, and, lastly, section 7.4 assesses whether the CDM has contributed to diffusion of wind power technology to the state of Rajasthan.

## 7.1 Transferring wind power to India

Europe (mainly Denmark, The Netherlands and Germany) and North America have been the lead markets for wind turbines since initial development began there. During the 1970s these countries initiated wind energy programmes backed by their governments with the goal of developing wind turbines in the megawatt class that could contribute substantially to the national electrical grid (Wizelius 2007). In 2006, 75 percent of global wind turbine sales came from four manufacturers based in the industrialized countries: Vestas (Denmark), Gamesa (Spain), GE (USA) and Enercon (Germany) (Lewis 2007). The four manufacturers are closely involved in the markets of China and India – two countries with abundant wind resources and governments supportive of wind power installations –because they see a promise of years of wind turbine sales (ibid.).

In the initial phases of the Indian wind energy programme the government imported wind turbines from the US and Denmark for use in demonstration projects. The projects served as tests of the equipment, aiming to see which parts had to be fitted to the Indian wind conditions (Gosh et al. 2002, Ravindranath et al. 2000). This is called indigenization and

> (…) "is associated with the process of acquiring or developing the capabilities, facilities and resources to produce modified versions/models of the machine and to undertake continuous R&D on different aspects of the machine" (Hossain 1991:83).

During this phase the government offered customs duty concessions for critical wind turbine components and simplified procedures for foreign investment, to boost local manufacturing (Rajsekhar et al. 1999). In 2009, Indian manufacturers achieved an indigenization level of 70 percent for turbines up to 500 kW, while manufacturers of higher capacity machines have a larger import content (Purohit & Purohit 2009).

According to the MNRE official, wind-power technology came to India in the mid-80s, through licensing and joint venture agreements with mostly Danish and

German companies. The MNRE official expressed concern that most of the technology came via licensing agreements[31], which only give limited rights to the Indian subsidiaries (MNRE official interview).

## 7.2 CDM's contribution to technology transfer in the wind sector

India is home to most unilateral projects, as mentioned in section 6.2. A unilateral project is not financed by an Annex I country, nor a centrally managed international fund. The host-country project developer, such as Suzlon, Enercon or RRB Energy, is responsible for finding investors, development and implementation of the project in order to receive the CERs. These can be sold to Annex I parties and generate an annual stream of foreign revenue for the project. In 2007, 85 percent of the total investment in Indian CDM projects came from India itself (Seres et al 2007). Viapradas, the CDM consultant, said that buyers from Annex I countries saw Indian CDM projects as too risky to provide the money up front. The risk was that the projects wouldn't be registered by the EB and they would not collect any CERs, leaving India to raise funds for its wind power projects domestically (Viapradas interview).

Unilateralism in CDM-projects can have unfavourable outcomes for developing countries, because it requires:

> (…) "significant institutional capacity and is less likely to lead to technology transfer, as the role of Annex I countries is limited to providing a supplementary stream of returns to an emission reduction project through purchase of CERs" (Sarkar 2006:60).

Seres et al (2007, 2008) found that technology transfer in connection to the CDM is more common among projects that have foreign participants, most likely

[31] A licensing agreement is when a foreign corporation issues a license to an Indian company with whom it agrees to transfer know-how, managerial expertise or technical services. The agreement is usually negotiated on a case-by-case basis, and therefore varies from company to company. The licence is granted because technology is often protected by international property rights (Kaplinsky 1990).

because these are larger in size.[32] In their study, Dechzleprêtre et al. (2008) draw the conclusion that the probability of a technological transfer is 50 percent higher in CDM projects implemented by subsidiaries of companies from Annex I countries. Enercon India is such a company, which claims in its PDD that they have “secured and facilitated (Enercon PDD 2005:5)” for a technology transfer for wind power technology from their German parent company, Enercon GmbH.

Studies have found that the rate of technology transfer in CDM has been quite low for India. Seres et al. (2007, 2008) and Dechezleprêtre et al. (2008, 2009) examine the PDDs for all registered CDM projects and look for indications[33] of technology transfer. The studies found that the rate for CDM projects facilitating technology transfer varied from 12 to 16 percent of all registered projects. For Indian wind-power projects, 23 percent indicated technology transfer. A quick comparison with China shows that this percentage is extremely low; 74 percent of all wind power projects in China claim international technology transfer; they are also larger in size (Dechezleprêtre et al 2009).

Looking at the numbers, it appears India prefers unilateral CDM projects. Another reason for the low rate of transfer may be that the Indian wind sector has all the technology it needs. Subramanian says that even though the technology in the wind sector has been imported, India is “…as good as any country.” There could be improvements in technology and especially in the operation and maintenance routines, but he says: “There is nothing that will force me to say that technology today is not up to mark.” Sarkar (2006) claimed that unilateralism is unfavorable for developing countries because it would not lead to technology transfer, due to a lack of institutional capacity. Subramanian’s and Viapradas’s quotes point to the fact that the Indian wind power sector has the capacity to

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[32] Size here refers to the amount of emissions of kiloton $CO_2$ equivalents per year (kTCO2e/yr). They write: “In summary, technology transfer is more common for larger projects; 36% of all CDM projects accounting for 59% of the annual emission reductions involve technology transfer” (Seres et al. 2007:6).

[33] The information collected from each PDD was: what kind of technology is used, does it claim a transfer, is it a transfer of hardware or knowledge, or both, where does it originate from etc. Both studies discount technology transfer within a host country.

provide the necessary technology itself, and therefore chooses to handle all aspects of CDM projects. As depicted in table 1, the sector reached the commercialization phase in mid-2000. At the same time, because India's policies for renewable energy provide enough financial returns on investment, Indian project developers are less dependent on CER sales.

To insure that CDM projects adhere to the precepts of sustainable development, all host countries and their DNAs must form their own sustainability criteria. India includes technology transfer in the last point of its sustainable development indicators:

> "**Technological well being:** The CDM project activity should lead to transfer of environmentally safe and sound technologies that are comparable to best practices in order to assist in upgradation of the technological base. The transfer of technology can be within the country as well [as] from other developing countries also" (CDM India b).

Even though the DNA has adopted a broad definition of technology transfer as opposed to the standard definition, everyone I interviewed pointed out that there has been no technology transfer in the wind sector as a result of the CDM. Amit Kumar, director of the Energy-Environment Technology Development Division at The Energy and Resources Institute (TERI) said:

> "See, there has been lots of technology transfer from the Netherlands and from the Germany, but to say that those technology transfer cases are because of CDM I'm not sure. I don't say that all our technology, and in case of wind, have been totally indigenous. All our companies are either joint ventures or extension of either a Dutch company or a German company. But that was in any case much before CDM came into force."

In Kumar's opinion the CDM has not contributed to transfer of new wind power technology. His opinion was shared by informants such as the MNRE official, Subramanian and Viapradas. According to them, the Indian wind power sector has arrived at the technological know-how-to-do-it stage because of the policies initiated by the Indian government, not because of the CDM.

In the next sections I will examine how the three companies I interviewed acquired their technology and their knowledge about the operation of technology.

The Enercon and Suzlon projects we discussed are registered as CDM projects, and have been issued CERs, while RRB Energy is undergoing validation for its project near Akal village. It will become quite clear that CDM has not played a role in technology transfer in these cases.

### 7.2.1 The workings of a Wind Energy Generator (WEG)

A WEG is a complicated piece of machinery with an equally complicated and sometimes confusing technical language. Before I go into the case studies and my informants' use of technical language, it is important to explain how a WEG functions. Figure 5 is from Purohit & Purohit (2009).

Wind energy is a benign energy source since it does not produce emissions or pollute water. When the wind blows at a high speed it bears a considerable amount of kinetic energy, also known as movement energy, which is converted into mechanical energy by rotating the blades and the generator, thereby producing electricity.

A turbine usually consists of a main tower, nacelle, blades, hub,

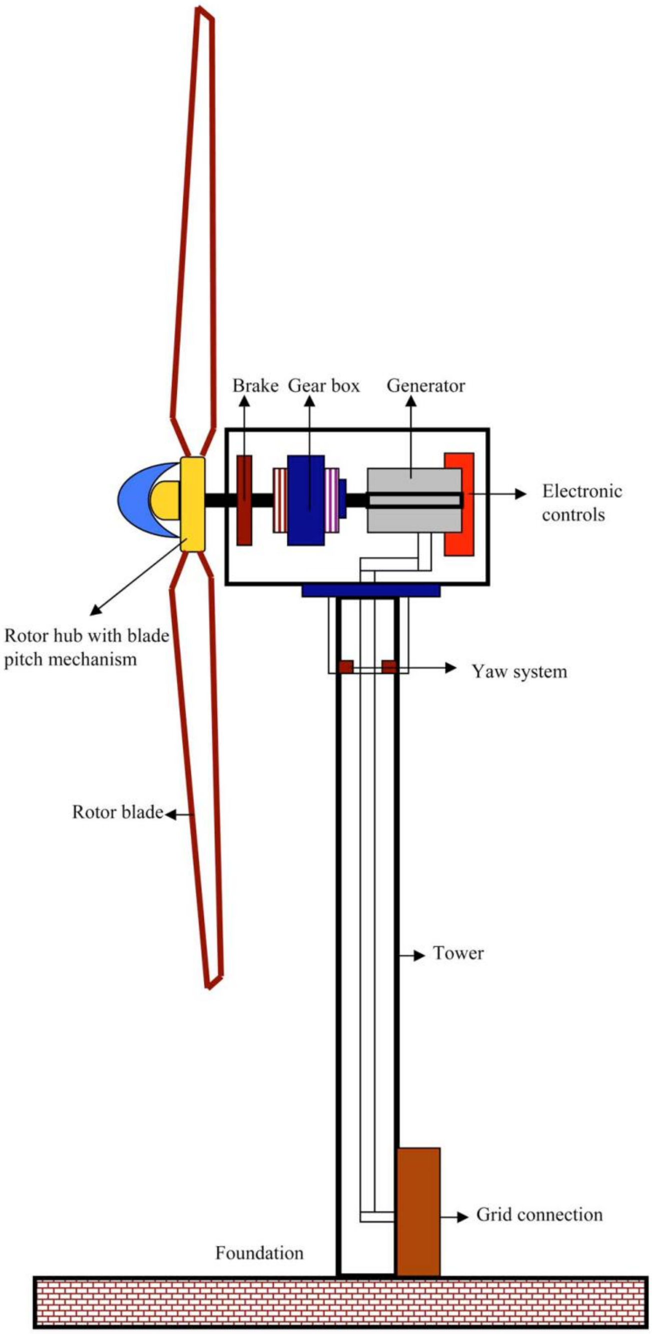


Figure 5. Schematic of a Wind Energy Generator (WEG)

bearing and housing. The most common name for this construction is a Wind Energy Generator (WEG). The tower heights for the three companies I interviewed vary from 50 to 80 meters. RRB Energy and, to some degree, Suzlon use lattice towers (open), while Enercon consistently uses tubular towers (closed). According to the Enercon engineer the tubular towers are more balanced and can withstand vibrations from the ground. They also hold better through a storm.

The inside of the nacelle holds the major parts: e.g., the gearbox, main shafts, brake and generator. The hub connects the blades and the gearbox. The gearbox is the key to electricity generation because it is used to transform the low speed of the wind rotor to a speed high enough to generate electricity. Extending from the rotor hub to the gearbox and generator are solid carbon steel bars or cylinders: this is the main shaft which rotates when the wind speed is high enough. Between the main shaft and the generator is the gearbox, which enables an increase of wind speed to the rated generator speed. The generator speed is between 1000 or 1500 revolutions per minute (RPM), while the rotor speed is usually between 15 to 30 RPM.

Suzlon and RRB Energy use WEGs with gearboxes, while Enercon relies on a gearless system. A gearbox requires constant maintenance, but, according to the Suzlon engineer the generation of power, is more consistent, and there is no need to draw extra power from the main grid to change the rotor speed. Turbines without gearboxes, called synchronous generators, require less maintenance, but are reliant on the grid to power the magnets in the rotor. These permanent magnets transform the rotor movement directly into electrical power. All of the companies I interviewed have blades with pitch control. Pitching is used so that the blade may follow the change in direction of the resulting wind. A yaw system is employed to turn the entire nacelle according to the wind direction; the nacelle can turn 360 degrees. The turbine responds to the wind speed in three different ways: cut-in speed, the wind speed necessary to start the rotation of the blades; rated speed, the speed when the turbine reaches its rated (maximum) power; and cut-off speed, the speed when the control system stops the turbine for safety reasons.

Electric controls are placed both inside the nacelle and in the control room. The controllers are involved in all decision-making concerning the wind turbine's safety systems. Inside the nacelle, these systems measure wind speed, voltage, current, temperature, yawing direction and more. This information is sent via the control room next to the tower, to the main control room where a technician monitors the performance of the entire wind power farm. The controllers report on errors in the turbines, and the complexity of a WEG is revealed in the fact that a machine can experience 300 different errors. In the Rajasthani desert, the main problem was high temperatures causing the turbines to stop; a safety feature was installed to prevent turbine overheating.

WEGs have a design life of 20 to 25 years, and their operation and maintenance (O&M) costs are usually from three to five percent of the total cost of a single turbine (Bonus Energy 1998, Wizelius 2007, Siemens 2008, Fornybar.no 2009, DWIA 2009, Purohit & Purohit 2009, Enercon interview, Suzlon interview, RRB Energy interview)

### 7.2.2 Enercon India

Enercon India Limited is a subsidiary of Enercon GmbH in Germany, and its commercial operation began in 1995 (Enercon India 2007). In the PDD, Enercon India states that it has:

> (…) "secured and facilitated the technology transfer for wind based renewable energy generation from Enercon GmbH, has established a manufacturing plant at Daman in India, where along with other components the "Synchronous Generators" using "Vacuum Impregnation" technology are manufactured" (Enercon PDD 2005:5).

This statement gives the impression that a manufacturing plant has been set up and technology has been transferred in connection with this project. But during my interview with the Enercon engineer it became obvious that the manufacturing plant was established a long time ago, and not in connection with this or other CDM projects.

Earlier I noted that the MNRE official expressed concern about Indian subsidiaries having limited rights to technology. This is indeed true for Enercon India. The Enercon engineer explained that 80 percent of the components for the WEGs are produced in India, while 20 percent is sent from Germany. The 20 percent includes power cabinets and software: i.e. the controller parts of the machines. He explained that Enercon India and Enercon GmbH have a mutual agreement in which the Germans have control over the main parts (Enercon-interview). In his opinion, the agreement works well, because the shipments from Germany are rarely delayed. This was because the Indians plan well and tell the Germans how many machines they need long time ahead of construction of a new site starts.

The largest Enercon turbine that is available in India has a capacity of 800 kW, and Enercon India only offers two types of turbines in the 800 kW range (Enercon-interview). Enercon GmbH, on the other hand, has a wide range of turbines up to 2, 3 MW which are suitable for Indian wind conditions (Enercon 2009). The international trend for wind turbines has been development towards larger and larger capacity turbines. India has jumped on this trend; in 2004 the biggest and tallest turbine in Asia to date[34] was installed in Chettikulam in Tamil Nadu (Mabel and Fernandez 2008), and both RRB Energy and Suzlon have turbines that operate above 1 MW. While the other company representatives boasted of installing and developing large turbines, this was not mentioned by the Enercon engineer. One can interpret Enercon GmbH’s failure to transfer larger turbines as technology control, mentioned by the engineer when he spoke of the Germans withholding the main parts of the turbines.

The CDM could have been used to finance a transfer of larger capacity turbines from Enercon GmbH to Enercon India. Because CDM has a positive effect on

[34] The turbine had an operating capacity of 2 MW, and was installed by Suzlon.

the IRR of a project, it could have been used to strike a new licensing agreement permitting the transfer of larger turbines between Enercon GmbH and Enercon India. Obviously this is not an issue for Enercon India, since they only have an agreement to manufacture and install smaller sized turbines. Enercon GmbH's motives for controlling the transfer of larger capacity turbines might be the fear of creating a competitor on the Indian market.  The Danish company Vestas experienced exactly that with its subsidiary, RRB Energy, which I will detail in the next section.

CDM status has no significance for the two engineers in Jaisalmer. They knew very little about CDM, even though they are in charge of the operation and maintenance of several registered CDM projects. The sites are treated in the same way, regardless of their CDM status. This was something that was pointed out to me by all three companies.

### 7.2.3 RRB Energy

RRB Energy started as a joint venture with the Danish firm Vestas in 1987. According to the RRB Energy manager, the Indians received on-site training from Danish engineers when the company was set up, in addition to hardware transfer. They do not claim technology transfer in connection with the CDM project, but the design of the WEGs is still Danish.

Today, RRB Energy is wholly owned by the managing director, Mr. Rakesh Bakshi, and buys its gearboxes from Vestas. The manager in Jaisalmer says that by the end of 2009 the company would be producing all of the parts themselves, even the gearboxes (RRB Energy interview).

Through their subsidiary relationship with Vestas, RRB Energy has managed to acquire enough know-how to develop the initial technology further, unlike Enercon. This was mentioned in my interview with the manager, and in newspaper reports. The technical agreement between RRB Energy and Vestas was such that the former would receive the Vestas technology for manufacturing only small turbines (under 750 kW), while the latter would continue to operate in the Indian market and manufacture turbines above 750 kW (The Hindu Business line 2006). Two years later, RRB Energy announced that they would also be moving into the large turbine market, and produce their own 2 MW turbines. This means that today they are in direct competition with Vestas, their former owner (IANS 2008).

The manager knew very little about CDM, except that it helps repay loans faster and provides for clean energy. To him, there is no difference between the operation and maintenance of a site registered as CDM and a site without CDM status.

### 7.2.4 Suzlon

Suzlon is a fully Indian-owned and Indian-initiated company, but it has also acquired technology via licensing agreements and takeovers of other manufacturing companies. Suzlon is a good example of how a firm from a developing country managed to play the field in the same way firms from developed countries have done. The company was established in 1995 by the Tanti family, who wished to diversify from the textile industry. Five years later, Suzlon made the top-10 list of global wind turbine manufacturers, and has stayed there since (Lewis 2007). Today it is the world’s fifth largest wind turbine manufacturer.

Suzlon took over Hansen, the second largest gearbox manufacturer in the world, in 2006, and the German manufacturer REpower in 2007. Suzlon’s manufacturing is mostly done in India, because of lower labor costs, while the research and development center is in the Netherlands to take advantage of the Dutch expertise in rotor blade design. Suzlon has also based its international headquarters in Aarhus, Denmark, where they hired Danish wind power workers purged when world-leader Vestas and NEG Micon merged in 2004 (ibid.).

At the Suzlon site in Baramsar that I visited, there were 38 WEGs with an operating capacity between 350 kWh and 1, 25 MW. This was a mixed site, with both CDM-registered (part of a 5-MW project spread over Baramsar and Soda villages) and non-CDM WEGs. Some of the WEGs were also registered as voluntary emissions reduction (VER) [35] projects. According to the engineer, the difference between CDM and VER is that the machines that register for VER have been installed during the last five years. The benefit, i.e. the money is lower for VERs. For CDM they get 0, 50 rupees per unit, while they only get 0, 25 rupees per unit for VER. The registration period for VER is 10 years, which is the same as for CDM projects. Suzlon has also two registered CDM project close to Soda village.

I was shown around the control room, and the Suzlon engineer explained that the software for the monitoring program (Control Monitoring System) was developed by Suzlon during the last year. Before that they leased software from a Danish company called Mita-Teknik, which makes controllers for wind turbines. The company has a research and development department in Pune that alters and develops software and control panels (Suzlon-interview).

The manager also explained where the different parts of the wind machines and controllers are manufactured. The transformer and the generator are manufactured in Daman, Gujarat. The blades and the tubular tower are manufactured in Bhug, Gujarat. The biggest generator (1, 25 MW) is manufactured in Pune, Maharashtra. The control panel and the capacitor panel are manufactured in Pondicherry in Tamil Nadu. Wanting to keep control over manufacturing instead of relying on external suppliers, Suzlon has pursued a line of in-house manufacturing to keep the costs down and enable fast delivery and assembly (Lewis 2007). As noted earlier, Seres et al (2007, 2008) found that the probability for technology transfer is higher when there is a party from an Annex

[35] VERs are reduction units that are not mandated by any law or regulation but originate from an organization's want to take part in reducing GHGs. The criteria for the VER are the same as for CDM. The emission units from VERs are called Voluntary Carbon Units (VCUs) and are sold in a global market. The market for VCUs is expected to be worth about US $4 billion in 2010 (Dnv.com, theclimategroup.org)

I country involved from the beginning. According to the Suzlon engineer, who works with these projects firsthand, the difference in technology transfer is minute because the projects are treated in the same way regardless of their CDM status. This might also be because Indian wind power developers have the technology they need and therefore prefer unilateralism in CDM projects.

Suzlon's strategy of relying on developed country expertise was also evident at the site. Further technological development of gearboxes is done in Germany by a Suzlon-owned company and then transferred to India. According to the Suzlon engineer, there is a Technology Completion Implementation Unit (TCI) in Germany that executes changes in the machines. TCI changes the parameters under which the machines must perform.[36] These are then implemented in India. According to Lewis (2007), Suzlon's style of international technical collaboration is unique in the wind business. Just like other global manufacturers (Vestas, Games and GE), Suzlon has established R&D centers in the middle of regional learning networks, but instead of relying on differentiated expertise within its own corporation Suzlon has accumulated extensive international expertise through licensing agreements, joint manufacturing ventures and R&D centers. This means that the company operates on several levels of international technology transfer; it is a receiver and a sender of technology.

## 7.3 Knowledge transfer in wind companies

Knowledge transfer is an important component of a complete technology transfer, and is characterized as the last stage in a transfer: i.e., the know-how-to-do-it phase. For a firm to reach this stage there has to be enough participation from the recipient, via on-site training and other organized classes designed to boost the level of knowledge. This was something Kristiansen (1993) assessed by studying several hydropower projects in Africa and Latin-America. The projects

[36] One example of a parameter is the temperature range in which gearbox functions. In the Thar Desert, the highest temperature the engineer experienced was close to 60° C, and the gearbox is programmed to cut-off at temperatures above 55° C. This cut-off temperature is programmed by the TCI.

were a mix of private enterprise agreements and bilateral aid agreements. He looked at what kind of training and education the transferees and recipients agreed upon in a legally binding contract before the transfer and what actually happened after the transfer. The contracts for the bilateral aid projects were quite specific about training, but little of it was actually carried out. In the cases where training of recipients was achieved, it was because the clients pushed for and utilized the options they were given in the contract.

As mentioned in section 7.2.3 about RRB Energy, the Indians received on-site training when the subsidiary company was set up in 1987. The manager further explained that there are some Danes employed in the company's blade factory in Chennai in Tamil Nadu. The technicians employed by RRB Energy must be university educated. It is fair to assess that a transfer of knowledge did happen, but it happened many years ago when RRB Energy began its collaboration with Vestas. Now they have moved further in developing their skills and knowledge about WEGs, and have enabled themselves to manufacture larger turbines.

In the study by Kristiansen, he was able to examine the technology transfers shortly after they happened. This was not possible for my study. For both RRB Energy and Enercon the transfers happened over ten years ago. But what I *could* examine was the level of dependency on the sender. RRB Energy initially received on-site training from Vestas, then broke off the collaboration and developed their own turbines. They also have control over their own manufacturing (RRB Energy 2009). This fits well with Kristiansen's definition of the know-how-to-do-it phase: "If we are talking about know-how-to-do-it in connection with (water) turbine technology, this implies technical and organizational skills to run a turbine plant" (Kristiansen 1993:12).

Enercon is still at the mercy of the mother corporation for the most important parts of the machinery, but they are also in a know-why phase when it comes to knowledge. Kristiansen (1993) defined the know-why stage as the phase where the recipient has gained enough insight about the underlying conditions in the technical and administrative processes so he can make repairs, adjustments and improvements on the hardware, organizational level and administrative routines in the production process. During the Enercon interview it became clear that the Indians have skills to maintain and repair the machines under normal conditions: i.e., normal Indian conditions. They have been trained to report on abnormalities which have an effect on the performance of the machines to the main corporation in Germany. It is in Germany that the kinks are worked out, meaning that the Indians are left in a know-why-phase of knowledge transfer.

The engineer told me about the Enercon training company in Daman where technicians and other newly employed personnel receive training. The knowledge transfer between Enercon GmbH and Enercon India happens here. The theoretical training for technicians lasts for six months, while the practical on-site training lasts one month. The engineer explained that the technicians learn about the standards and parameters during their training. These are set by the German mother company, and according to him it is the standards that separate Enercon India from other wind power companies. The standards are evaluated by a company division called Service Installation and Quality Assurance department (SIQA).

SIQA is there to insure and guarantee quality. Because of the connection with the Germans, Enercon India has more standards they must follow than the other companies, according to the engineer. If SIQA finds any deviation from the standards, the equipment and procedures will be rejected. The second engineer from Enercon, whom I interviewed prior to visiting the wind sites, explained that the collaboration with Enercon GmbH persists:

> "The Germans still visit. They are visiting every year. They are doing this on a sample basis. They are doing auditing, quality checks…. All these things they are checking. Whether norms, standards, quality norms are maintained or not. Basically it's a reputate [reputable] company. It's a process of verifications, that's why they are doing the audits. They want to insure same standards" (Enercon interview with engineer 1).

He further went on to explain that Enercon India complies with all the Enercon GmbH standards and benchmarks. He also indirectly suggested that this collaboration was a two-way street, saying that there are Indians in Germany getting training. In India, the machines experience completely different problems from those in Germany, where they were developed. The biggest problem in India was heat, so this had to be communicated back to the Germans by sending data related to heat-induced errors in the WEGs. Then they would work on altering the "…softwares and other things (ibid.). They are continuously improving the performance of the deviations".

RRB Energy and Enercon India started off in the same way, as subsidiaries to two of the world's largest wind turbine manufacturers, Vestas and Enercon GmbH. The former has gone through all the steps of technology transfer, while the latter still has some way to go. Even so, there has been a transfer of knowledge to a large number of Indian professionals, and their capacity for operating wind power projects has increased substantially.

In the previous sections, I described how the Indian government initiated a push for renewable energy technologies. As a result of a multi-faceted policy, India has become a country with a competent and globally competitive wind sector. The CDM has not contributed to technology transfer or knowledge transfer to the country from abroad. But if one is to look at the distribution of CDM projects within the nation, it is a different story.

## 7.4 Diffusion of wind power technology to Rajasthan

The core states for wind power and wind power manufacturing are Tamil Nadu and Maharashtra; all of the three companies I interviewed have their headquarters there. These two states, and Gujarat, have been at the forefront of installing wind power. Tamil Nadu has utilized over 90 percent of its wind power potential, Maharashtra over 50 percent and Gujarat 16 percent (C-Wet 2009b). The outcome has been that the geographical distribution of Indian CDM projects is mainly concentrated in these three states. But Rajasthan, which fully grasped the benefits of wind power in 2000, and Karnataka have also garnered a major share of the wind power CDM market. This is displayed in table 2.

The aim of this section and one of my subsidiary aims is to find out if *the CDM has contributed to diffusion of wind power technology to the state of Rajasthan.*

The MNRE official mentioned that the CDM might be beneficial for states with a low-to-medium wind regime, such as Rajasthan (MNRE-official interview). Here, the initial investment in WEGs is high and returns are low because the WEGs produce less energy.

Table 2. Wind power statistics of India

| | **Installed capacity in MW** | **Gross potential** | **Technical potential*** | **Rate of utilization** | **CDM-projects in wind^** |
|---|---|---|---|---|---|
| Tamil Nadu | 4304,5 | 4750 | 1750 | 91 % | 81 |
| Mahara-sthra | 1938,9 | 3650 | 3020 | 53 % | 82 |
| Gujarat | 1566,5 | 9675 | 1780 | 16 % | 43 |
| Karnataka | 1327,4 | 6620 | 1120 | 20 % | 46 |
| Rajasthan | 738,4 | 5400 | 895 | 14 % | 27 |
| Madhya Pradesh | 212,8 | 5500 | 825 | 4 % | 5 |
| Andhra Pradesh | 122,5 | 8275 | 1750 | 1 % | 2 |
| Kerala | 27 | 875 | 605 | 3 % | 1 |
| West Bengal | 1,1 | 450 | 450 | 0 % | 0 |
| **Total** | **10239,1** | **45195** | **12195** | **23 %** | **287** |

* Statistics from 2002. Technical potential is the ability of wind power to penetrate the grid without affecting its stability.
^ Number of registered CDM-projects from 01.01.2009
**Source:** C-Wet 2009b, UNEP Risoe CDM Pipeline January 2009

Therefore it is easier to prove that wind power projects are additional to the business-as-usual power generation. In the previous chapter, the growth of the CDM in India was explained by the wind power manufacturers' all-in-one business model, where all aspects of wind power installation, including CER benefits, are included in the initial investment. This is also relevant for Rajasthan.

### 7.4.1 Wind power development in Rajasthan

In India, the states decide for themselves how they should organize access to renewable energy and access to energy in general. Prior to liberalization of the electricity sector in the early 1990s, the State Electricity Boards (SEBs) were the power utilities in charge of generation, transmission and distribution of electricity. During the 1980s and 1990s, the power sector was plagued by huge deficits, unsustainable and regressive subsidies and large-scale theft (Lal 2006). The central government in New Delhi instructed the SEBs to achieve a rate of return of three percent on their net fixed assets after interest (REDA 1999a).

The Indian state of Rajasthan was no different: the Rajasthan State Electricity Board (RSEB) suffered from service interruptions, high system losses, poor cost recovery and heavy commercial losses. Rajasthan experienced chronic power shortages up to 36 percent during peak hours and overall energy availability shortage of 11 percent. 600 000 of its citizens were waiting to be connected to the state power grid, and the RSEB was in desperate need of funds (REDA 1999a). It decided to initiate wide-ranging reforms; one of the main components was to open for private investments in 1993. In order to increase efficiency and minimize loss, the World Bank provided funds for the RSEB to unbundle its power utilities into three separate entities of generation, transmission and distribution (Lal 2006).

Privatization was a general trend in India during the 1990s, and in 1996 and 1998 the energy ministers from the different states met with the Union government minister to discuss energy policy. They agreed on a Common Minimum National Action Plan on Power and started work on reforming the Electricity Act of 1948[37].

[37] Private investment in the Indian energy sector was until 2003 defined by the Electricity Act 1948. This law prohibited "(…) individuals, communities or cooperatives to generate or distribute power" (Chawii 2002a: 5), large scale private power generation was only allowed as long as the power was sold exclusively to the state SEBs. These had pre-determined rates, at subsidized cost, which were an impediment to the visibility of investment (ibid.).

Along with the final policy for unbundling the state power utility from 1999, the Rajasthan state government also adopted a policy promoting electricity generation from wind (REDA 1999b.) But due to the lack of funds, only a few megawatts of wind power were installed during 1993-1999.

The aim of the wind power policy was to achieve 100 MW of future electricity installation exclusively from wind (REDA 1999c). The target was met only after the state government proved through several demonstration projects that private investment in wind power in Rajasthan was profitable and possible. In March 2005, the total installed capacity reached 284 MW; of this, 278 MW came from private sector projects. The capital for the demonstration projects came from both from the private and public investors. The private companies, among them RRB Energy[38], were guaranteed long-term contracts, received tax breaks and could sell the power at a yearly increasing rate of five per cent (REDA 1999b). Investors had to have previous experience of setting up wind power projects of at least 7.5 MW in India and net funds of at least 500 million rupees (approximately US $11 million) (ibid.).

According to the RREC official, several wind power developers and suppliers, such as the three companies I interviewed, have been involved in the installation of wind farms in Rajasthan since 1999/2000. Rajasthan has windswept desert lands, such as the Thar Desert outside of Jaisalmer, with medium wind speeds (6-6, 4 m/s). In order to attract investors and developers the government of Rajasthan has provided them with land at concessional rates (RREC-official e-mail correspondence). Under the new policy, land was granted for 20–year periods at ten percent of full cost, but this was only for sites that were identified by the Centre for Wind Energy Technology (C-WET) as suitable for wind generation (Jaisalmer RREC-official interview).

[38] In 2000, RRB Energy was still a joint venture with the Danish wind power company Vestas, and went under the name Vestas RRB. They provided the WEGs for a demonstration project in Chittorghar, while two other demonstration projects were erected in Phalodi and Jaisalmer. The funding came from MNRE in form of a 2, 54 million $ US grant and from the private companies.

Wheeling charges were initially set to two percent of the total energy fed into the state grid. A wheeling charge is a fee charged by the Rajasthan Electricity Regulatory Commission (RERC) to wind energy producers when they connect to the grid and store an amount of power production to avoid the problem of intermittent quality of power (REDA 1999c). But by 2004 the wheeling charge had risen to ten percent (RRECL 2008b, Purohit and Michaelowa 2009). Gosh et al. (2002) point out that the growth rate of India's wind power capacity experienced a decline due to tax revenue losses across states that gave tax breaks for new wind installations. An increase in wheeling charges in Rajasthan can thus be explained: the tax revenue losses proved to be unsustainable for the government budget. Several states with good wind power potential did the same thing; in 2002 Karnataka imposed a wheeling charge of 20 per cent and Gujarat increased the charge to 15 per cent (Chawii 2002b). This is an example of the inconsistent state policies that industry experts (Viapradas and Kumar 2008, Makhija 2008, Singh 2008) pegged as one of three major problems constricting the growth of the wind power sector. Even so, according to newspaper reports, Rajasthan managed to attract investments of 487 billion rupees (approximately US $9 million) in 2004, despite the fiscal irregularities in the state and high wheeling charges (Thapa 2005).

My informants all pointed to the favorable tariffs and easy access to land as the main reasons for establishing wind farms in Rajasthan. Large tracts of land in Rajasthan are classified as barren or common, meaning that they belong to the state government. Land acquisition was the second problem that experts said were impeding further expansion of the wind power sector. Recently, the RERC raised tariffs for wind power farms established during 2009/2010. Those wind power producers will sell their power to the state at Rs. 4, 28 per kWh, while the rate until 2009 has been Rs. 3, 38 per kWh (RERC 2009). Regardless of the recent increase, the Rajasthani tariff has been one of the highest in the country since the beginning of 2000. The Enercon engineer also mentioned that payments from the utility company are usually on time (Enercon-interview). This, coupled with affordable land prices and progressive state policies, is attractive for wind power developers such as Enercon, Suzlon and RRB Energy.

The core states, illustrated in table 2, have also reached a saturation point for wind power; there is less land availability for wind power sites in regions with high wind speeds. Thus developers hunt for new markets in the lower category of wind speeds. This has led to a diffusion of technology to Rajasthan, which, before 1999, lacked any wind power technology. Their investors are introduced to the CDM because it has largely become a part of the investment package, as long as they can afford the registration fees. This is illustrated in the answer I got from the RREC official to the question of whether the CDM benefits have attracted wind power developers to his state. In the last sentence, the RREC official claims that wind power projects are financially viable even without CER revenue:

> "CDM made it more preferable to facilitate for wind energy in the state for those who have taken the advantage of CDM. On the other hand it is true that the procedure of registration in UNFCCC is too typical and lengthy that every one cannot maintain patience for the same. If it is considered from other view point, then CDM is additional benefit to the project and improves the cash flows of the project. But now days this benefit is generally predetermined and projected to show the project more financially viable" (RREC-official e-mail correspondence).

## 7.5 Summary

India has a well developed wind power sector and policies that strongly favor the installation of wind power. These policies have resulted in India's emergence as the fifth-largest wind power country in the world. At the same time, Indian wind power sector has captured half of the global CDM investments. However, since the sector reached the technological know-how-to-do-it phase long before the CDM was initiated, the registered CDM projects have mostly been unilateral. It is therefore not possible to conclude that there has been any technology transfer to the wind sector in connection with the CDM. Knowledge and hardware transfer has rather occurred due to the past ties between global companies and their Indian subsidiaries.  This means that the CDM has not added any additional value in securing higher capacity wind power technology.

The state of Rajasthan is a latecomer to wind power installation. The first occurrence of wind power installations happened after extensive power sector reforms in 1999. Considering that the state has only utilized 14 percent of its wind power potential to date, it has already taken a substantial share of the Indian CDM market. However, the CDM has only had a marginal effect on the development of wind power in the state. My fieldwork showed that investors are attracted to wind power in Rajasthan because they can take advantage of favorable state and national policies. It is these policies, and not the CDM, that have effected diffusion of wind power technology to the state of Rajasthan.

# 8. The local consequences of the CDM

In the previous chapter I established that the CDM has not accomplished technology transfer or fostered technology diffusion to the wind power industry in India and the state of Rajasthan. In this chapter I will focus on the sub-question: *what has been the contribution of CDM projects in wind power to the area of Jaisalmer in the state of Rajasthan?*

Rajasthan is perceived as a state with a low-to-medium wind power potential. The first wind power companies were established in 2001, attracted by favorable land prices and tariffs. Today, all the major wind power manufacturers have regional offices in Jaisalmer or Jaipur and the total installed capacity is 738 MW.

In the first section I will give a short description of the villages Soda and Akal, before I go through what the villagers expect from the wind power projects. This will be compared to what the wind power companies claim that their projects have contributed to. I have divided this chapter by using some of the sustainable development indicators developed by Olsen and Fenhann (2008), and parts of their taxonomy for assessing the benefits of CDM projects. I have chosen to use two dimensions – social and economic – while I have excluded the environmental impacts. Environmental consequences are also important, but have not been directly addressed in this study.

Olsen and Fenhann's (2008) indicators are designed to evaluate large volumes of CDM projects by studying the PDDs and ultimately produce a quantitative analysis of sustainable development. The indicators are therefore not ideal for a qualitative analysis of only three CDM projects. Still, they are valuable as a way of organizing and prioritizing the qualitative data.

## 8.1 Soda and Akal villages

Soda village is located about 60 km from Jaisalmer and has about 80 houses, according to the villagers themselves there are 10 to 15 people per house. The villagers grow *bajra*, a pearl millet which is common on the Indian subcontinent, on plots some kilometres outside of the village. Their main source of income is animal husbandry, and most families have cows, camels, goats and horses. The animals are allowed to graze on the windmill sites. Like most Indian villages it is divided by caste, and in Soda there are six castes with *Rajputs* as the highest caste. The village is surrounded by wind turbines from Suzlon (9 turbines erected in 2004) and Enercon (97 WEGs throughout the whole area) erected in 2005. The land on which all WEGs surrounding the village stand belongs to the Rajasthani government. The village does not have access to electricity.

Akal village is located approximately 22 km from Jaisalmer; there are about 600 people in the village. Their income source is the same as in Soda village: farming of *bajra* and animal husbandry. According to the villagers I interviewed, the whole village consists of *Rajputs*. Suzlon erected their WEGs in 2005 and RRB Energy in 2006 on government land. Suzlon has not yet started a CDM project cycle for this site, while RRB Energy is in the validation process for theirs. The village has had access to electricity for 20 years. Each household pays 1600 rupees a month to the state's electricity board (RSEB) and they get six hours of electricity a day. This is mostly during evenings and they use it to power fans, millet grinding machines and tube wells. There are eight tube wells in the village.

In India, there are over 300 million poor people and the number has remained steady during two decades of rapid development. Poverty is most prevalent in rural areas. The poverty line in India, set at 10 rupees a day (US $0, 22), is well below the international poverty line of 1 US dollar per day per person. Rajasthan is not one of the worst poverty stricken states;[39] still 22 percent of all Rajasthani survive on less than 10 rupees a day (GOI 2006).

## 8.2 Economic contribution

Olsen and Fenhann's indicators measure only positive contributions to sustainable development since this is what is highlighted by project proponents in their PDDs. Through interviews with villagers, however, it is possible for me to also say something about the negative aspect of the CDM projects and asses the benefits. The dimension "economic benefits" includes three criteria: growth, energy and balance of payments. Table 3 shows which indicators are included under each of these criteria.

Table 3. Economic indicators

| **Dimension** | **Criteria** | Indicators | Descriptions of benefits not included in each criteria |
|---|---|---|---|
| *Economic benefits* | Growth | Support for economic development and stability through initiation of e.g. new industrial services, investments, establishment and maintenance of infrastructure, enhancing productivity, reduction of costs, setting an example for other industries and creation of business opportunities. | Income-generating activities at individual level are considered an employment benefit. At company, sector, industry or country level income generation is considered a contribution to growth. Tax benefits are generally considered a contribution to welfare; unless it is explicitly stated it is used in support of local economic activities. |
| | Energy | Improved access, availability and quality of electricity and heating services such as coverage and reliability | Benefits of electrification especially in rural areas such as improved welfare, education, health or other aspects of SD are included under each criterion when they are explicitly mentioned |

### 8.2.1 Growth

All three companies state in their PDDs that the main purpose of each CDM project is to generate electricity for the national grid. However, according to the PPs, their projects have greater value than just electricity generation, as they will also contribute to "rural and infrastructural development, help in economic and

[39] India's national poverty rate is at 27, 5% in 2004. The states with the highest poverty rates are Orissa (46.3%), Bihar (41.3%), Madhya Pradesh (38.2%) and Uttar Pradesh (32.8%). These are also the most populous states of India.

social development of remote villages in Rajasthan to make investment in that area" (Suzlon PDD 2006 b, c.: 3, RRB Energy PDD 2006: 3). It is common practice for all three companies to hire external contractors to construct a site (Suzlon engineer, Enercon engineer and RRB Energy manager). In each project the contractors came either from the city of Jaisalmer or from other villages then Akal and Soda. The reasoning behind using external contractors from the local area is that it saves time and money for the companies. It would take too long to bring in contractors from, for example, the states where each company has its headquarters (Suzlon engineer). Building a site involves many types of personnel who work in the construction sector: electricians, crane operators, machinery operators, drivers, mechanical engineers, etc. (RRB Energy manager). Tendering out construction work is considered by the companies as a positive contribution to growth because it creates income generation in the construction industry in the Jaisalmer area. Hiring local contractors is considered as giving direct, temporary employment to locals (RRB Energy manager, Enercon manager 1).

The villagers on the other hand are not pleased with this type of arrangement. They can only gain employment as casual laborers, while it is the villagers' desire that the companies lease and pay to use their equipment such as jeeps and tractors to construct a site. In both Soda and Akal the villagers said that they, as a village, gain nothing when companies bring in people from "the outside." They want the companies to focus more on hiring the villagers because *they* are the locals, not the contractors from Jaisalmer. The Suzlon engineer mentioned that this was a demand from the villagers: "They want employment… But he is not educated. They want contracts for vehicles, but we give them support. Then the people have benefits from Suzlon sites. This is standard for Suzlon sites." All of the companies mentioned that the villagers were uneducated and therefore unqualified for higher positions than casual laborers or security guards. Still, in the view of the engineers and manager their companies have contributed to local economic growth.

Suzlon has acquired an area of 700 acres (2, 83 km²) around Jaisalmer to establish windmill sites and has built roads through this area. All companies have built roads leading to on-site offices and the individual WEGs. The two engineers from Suzlon and Enercon and the manager from RRB Energy emphasize their contribution to improving the infrastructure in the area where the projects are situated. It is exemplified in this quote from the Enercon engineer:

> "The project is a benefit to the villages. There are good roads. Infrastructure is developed. People are getting to the village by good roads. Other features are also incorporated; the coverage of the mobiles for the village is there. They have invested due to us, because we are going in that area and people are visiting more and our employees are using mobiles so they request the local agencies. So that improvements has been developed in those villages. There are mobile connections, transportation, and roads up to the villages... other than employment" (Enercon engineer 1).

The villagers of Akal and Soda did not mention that their mobility to and from the villages had improved. The roads which lead up to each WEG have had a negative effect on the Soda villagers. The roads closed off irrigation canals which lead rain water to farm fields. The villagers have asked both companies to unblock the canals, but this has not been done. This problem is also cited in the section "Stakeholders comments" in the PDD for one of the CDM projects[40] in Soda village. Suzlon writes, "(...) Sun-n-sand on behalf of the project proponent has requested the operation and maintenance contractor to take initiatives in leveling the debris and filling up the pits created during the road construction" (Suzlon PDD 2006c.: 21). The stakeholders meeting was held in 2005, but according to the villagers the debris and the pits created during construction have not yet been taken care of.

Even though the villagers did not consider new roads as a positive contribution to them, it is a positive benefit according to Olsen and Fenhann's indicators. During my fieldwork, the engineers and manager drove me out to the sites where it was

[40] The project proponent is a hotel chain, Gujarat JHM Hotels Pvt. Ltd, and the operation and maintenance is done by Suzlon. As I mentioned in the Methods chapter, Suzlon does O&P on the three CDM projects in Soda village.

clear that the new roads[41] improved accessibility to the sites, and also to the villages because they are in the immediate vicinity.

The CDM process, hailed as a multi-stakeholder governance arrangement, was designed to foster transparency and accountable methods of environmental action at the global level. The keyword is legitimacy, divided into input and output. I covered input legitimacy in chapter 1, section 1.5, and explained the three procedural qualities of transparency, accountability and participation, in regards to the CDM project cycle. In global governance agreements, such as the CDM, the voices of those who cannot participate must also be heard. That is why stakeholder meetings are mandatory and a prerequisite for validation (CDM rulebook Stakeholders). Participation is not complete if there is no response to the stakeholders' concerns. Without it, participation is only an act to legitimize the power structure within the system (Lövbrand et al. 2009). The villagers were given an opportunity to voice their concerns about the wind power project, but their concerns have not been responded to. I will come back to legitimacy of the CDM projects in section 8.3.

Enercon has contributed mostly to socio-economic development of the city of Jaisalmer, as opposed to villages closer to their wind power sites. The company has built two temples, one police station and donated to build a part of a sports stadium. The engineer also mentioned that they had built a road leading up to the village, but did not specify which village this was. According to him and as a part of their corporate social responsibility (CSR) activities they have donated money per installed megawatt to the state government so it can develop the infrastructure in "that" village (Enercon engineer 1). As far as setting an example and creating opportunities for other businesses, the wind power companies have made a contribution to the economic growth of the Jaisalmer district. They have also done so on a long-term basis, since their offices will at least be operational during the 20-year lifespan of a WEG – and likely more because the companies

[41] Even though they are not of high quality, most of them are gravel roads.

are continuously installing new WEGs. But the companies have made a minimal impact on the economic growth in the affected villages of Akal and Soda.

The three companies have contributed to investments in the Jaisalmer area. The question is if they have done so because of the CDM. The RREC official stated that Rajasthan, with its untapped wind potential, is a good investment opportunity. The Rajasthan state government devised a policy to attract private investments in the wind power sector; government land is deeded for 10 percent of full cost for 20 years, and power producers are given higher tariffs than in other states when they sell the power to the regional grid. The RREC official is under the impression that the CDM makes it more appealing to invest in wind power for those who are willing to undergo the risks of participating in the process.

He also stated that many of the wind power projects could have been established without the financial help from the CDM. Therefore the CDM has not contributed to investments in the state; it is the state's policies which have created a trickle-down effect for job creation, attracting qualified personnel to the state and development of the energy system. The state has assumed the role of enabler (Barry 2005, Jänicke and Jacob 2005) to increase economic growth. This is in line with sustainable development objectives and ecological modernization because the state has chosen to attract businesses which will alter the energy system away from fossil fuels. The trickle-down effect of the state’s action has to a large extent benefited city centers such as Jaisalmer where the companies have their main offices. Sustainable development goes a step further than ecological modernization, and emphasizes that economical growth should also be socially sustainable. To put it simply, even the state's own policies have so far not ensured that increased economic growth is socially unbiased: i.e., beneficial for the poorest population of the Jaisalmer area.

### 8.2.2 Energy

Rajasthan has a gap between the demand and supply of power, and, according to the RREC-official, the CDM projects have had some benefits for the overall generation of electricity in the state:

> "As it is aware that there is a big gap between Demand & Supply. If CDM can benefit to the investors of wind energy then it will promote them to invest in wind energy sector. This will result in improved generation which finally reduces the gap between Demand & supply" (RREC official e-mail correspondence).

The companies themselves also state that improved electricity generation in the state is the main reason behind establishing wind power projects and registering them as CDM (Suzlon PDD 2006a, b, c, Enercon PDD 2005 and RRB Energy). It is difficult for me to assess to what extent the wind power installations have contributed to the overall electricity generation in Rajasthan as such data is not readily available. Rajasthan has 27 wind power projects in the CDM pipeline, while nine are registered. These nine projects total 141 MW, while the entire state had 738.4 MW of wind power installed in 2009 (UNEP Risoe CDM Pipeline 2009, C-WET 2009b). Since CDM projects make up a large share of the total installed wind power capacity (20 percent of total installed wind power), it is presumed that these have also made a contribution towards increased generation. But as I mentioned earlier, the RREC-official stated clearly that many of the wind power sites which are now registered CDM projects would have been established regardless of the existence of the CDM (RREC-official e-mail correspondence).

When it comes to improved access to electricity I will assume that this indicator refers to access for those who have not had it before and increased access for those who already have electricity. The villagers of Soda stated that they would like electricity, so they could use it for running millet grinding machines, tube wells and lights. This is exactly what electricity is used for in Akal village. The villagers of Akal stated that the windmills are a good contribution because they produce electricity. But they wanted a constant supply of electricity, not just the six hours a day they get from the RSEB.

With regard to providing electricity directly to those villages that do not have it, the engineer from Suzlon and Enercon explained that this was too costly. The company would have to build substations to convert the power and the customer would also lose money if electricity is given directly to the villagers. Instead, Suzlon acts as a middleman towards the RSEB on behalf of the villagers:

> "If a village has electricity and they tell us that they need one hour extra, then we communicate it to the RSEB. They usually get it. Nobody hears the voices of the villagers. We are middle men, but we do not pay for the extra electricity the villages get. The villagers do that themselves" (Suzlon engineer).

Ultimately, providing access to electricity for the villagers is up to the state government and the electricity board:

> "We are not authorized. The state government has not allowed this, we have to (unclear recording) with them and use the money for that, to make infrastructure. Then they will call different tenders for work and then they will initiate the work. Because we are the private companies, so we cannot do government work. It is the state government activities" (Enercon engineer 1).

Engineer 2 was quick to add that: "So far as social economic development is concerned, we are helping, we are building temples and schools and some other things."

Providing access to electricity is a governmental responsibility in most countries, and therefore it would be expecting too much of private companies to build the energy infrastructure as well. On the other hand, it is not unheard of in India. Some state governments such as Tamil Nadu pledged to build transmission lines as long as industrialists invested in wind power (Subramanian interview), and in that way directly improved their power infrastructure.

This has not been the case for Rajasthan, and numbers from Rajasthan Energy Department show an incremental growth of transmission and distribution lines[42] (Rajenergy 2007). But due to lack of updated numbers for the last five years, it is not possible to say if increased wind power installation has had any effect on the infrastructure of the power system in Rajasthan. Even so, if the government of India wanted to take full advantage of the companies' increased CDM revenues; it could have secured some of it through taxes. The tax revenue could have been used to upgrade the energy infrastructure of the country and thereby increase access to electricity for the poorest population. But due to the design of the CDM, which allows national DNAs to define their own sustainable development standards, the Indian DNA has not, unlike the Chinese DNA, allowed for taxation of CER sales. In chapter 4, I posed the question whether the fusion of the approaches on sustainable development and ecological modernization via the CDM has been successful in real life. The case of Soda and Akal villages is of course too small for generalizing, but it might serve as an illustration of some consequences of choosing ideas of ecological modernization over sustainable development.

## 8.3 Social contribution

The dimension "social benefits" has four criteria: employment, health, learning and welfare. I will only apply employment and welfare criteria because these are the ones that are valid for the interviews with villagers and company representatives in Jaisalmer. I've also included the dimension "other benefits" in the section with the criteria "corporate social responsibility". This is because all three companies mentioned CSR activities. Table 4 explains the indicators for social contribution of CDM projects.

[42] From 2002 to 2005 the building of transmission lines (high-voltage lines from generating plants such as wind power sites to substations where electricity is fed into the main grid) increased by 7, 7%, while new distribution lines (low voltage lines of 33 kV and 11 kV that go to consumers) amounted to 8, 2% and 9, 1% respectively (Rajenergy 2007).

### 8.3.1 Employment

During the construction period in 2004, the villagers of Soda village say that they gained employment for approximately two weeks. They worked only for Suzlon, but not directly; they worked for contractors from Jaisalmer hired by Suzlon. The villagers of Akal did not find employment during the construction period of the WEGs for RRB Energy and Suzlon. During the construction period in 2004 in Soda village, Suzlon hired contractors from Jaisalmer who again paid the villagers 70,000 rupees (approximately US$1500) for building roads and

Table 4. Social Indicators

| **Dimension** | **Criteria** | **Indicators** | Descriptions of benefits not included in each criteria |
|---|---|---|---|
| *Social benefits* | Employment | Creation of new jobs and employment opportunities including income generation. | Indirect, informal or part-time activities-such as waste collection-are included as employment benefits. |
| | Welfare | Improvement of local living and working conditions including safety, community or rural upliftment, reduced traffic congestion, poverty alleviation and income redistribution through e. g. increased municipal tax revenues. | Tax benefits used in support of economic development is accounted as an economic benefit. Tax benefits used for public service purposes are welfare benefits. |
| *Other benefits* | Corporate social responsibility | Support for ongoing corporate social responsibility activities that are indirect or derived benefits of the CDM project activity. | |

working on the control rooms. The money was divided among all the men who worked– in their words, the entire village. Now there are eight men in the village working as security guards on the Suzlon windmill sites, and they are paid 3000 rupees (approximately US$65) a month.

There are approximately 20 people from Akal working for both Suzlon and RRB Energy as security guards. The payment is the same as in Soda village. One of the men I interviewed has been working as a security guard for the past three years. He works 10 hours a day and sometimes also during nights, but none of

the security guards are paid more for nightshifts. The security guard expressed that he wanted higher wages; he worked in the city before and made more money.
During the construction period of the Enercon WEGs the villagers of Soda were not employed at all. They are dissatisfied with how Enercon executed the project, because the villagers have not gained from it. According to the villagers, Enercon has not offered them any type of services after the windmills became operational. Nor have any of the villagers been employed as security guards by Enercon.

The companies prefer to give the villagers work as casual laborers or security guards because the villagers are uneducated. Enercon has also employed some villagers as canteen servants. Both Enercon and Suzlon support the villagers through CSR activities. All three companies state in their PDDs that poverty alleviation will be achieved by "(...) establishing direct and indirect employment benefits (Suzlon PDD 2006a:3, RRB Energy PDD 2006: 4)" either through investment in a backwards area or through short-term employment. Suzlon states that, in the projects located at Soda and Baramsar villages, the impact on the villagers is downplayed because they "(...) are nothing but scattered hamlets of few habitants residing near the project site" (Suzlon PDD 2006a: 25). RRB Energy writes in their PDD (RRB Energy PDD 2006: 25): "The project activity has been implemented in the barren area where no human habitation is present within the radius of 3-4 km."

The men in both villages wanted more employment, but the villagers of Soda were happy with the medical services they have received from Suzlon. In Soda village the men stated that their situation had not improved since the WEGs were erected, even in terms of having more money. They wanted more employment especially from Enercon. The villagers told the story of being thrown in jail by those who run the windmills. They are allowed to let their animals graze on the windmill sites during daytime, but when it gets dark they are not allowed onto the sites. One time some of the villagers went looking for their lost animals during night time. But the security guards on the windmill site stopped them and accused them of stealing. The village men were put in jail for this accused crime, and had to spend money on attorneys to get them out of jail and resolve the matter. The villagers expressed anger with the companies for this. They have lost money because of the legal case with one of the companies and with regards to the irrigation problems.

The villagers of Akal expressed that they had not suffered any losses due to the WEGs. Those who are employed as security guards are content, while those who are not employed want jobs as security guards. They also mentioned that they could work as mechanics, but none of them have a formal education: i.e., a diploma documenting their mechanical skills.

The construction of the windmill sites around Soda and Akal villages has made a contribution to employment in form of new job creation. However, the majority of the jobs offered to the villagers have been short-term, in form of casual labor during construction. There is also reason for questioning if employment opportunities were given to the villagers because the projects are registered as CDM. The Suzlon engineer explained that villagers are hired on a needs basis; this is irrespective of CDM status.

CDM projects in renewable energy are not designed to alleviate rural poverty, according to Sirohi (2007). They are rarely directed towards improvements in the agricultural sector, nor do they provide paid and long-term employment for the most vulnerable groups (rural poor) and in the most affected geographical areas (the poverty stricken states). CDM projects offer long-term employment opportunities only for those with technical and advanced skills. The rural poor do not possess such skills and Sirohi states that "(…) even in the areas where CDM activities are coming up, it would not be surprising that the employment growth in operation of CDM projects may totally by-pass the rural poor" (2007:99). A lack of skills was the main reason for why villagers were not employed by the wind power companies.

In Soda village the villagers have suffered due to companies need for security. Because the security guards who accused them for stealing are not from their village, i.e., didn't know them, they have lost money on resolving a conflict with the wind power company. There hasn't been any conflict in Akal because the security guards on the sites closest to their village are their own people. The wind power companies consider all villagers as the same; there is no differentiation between who they hire as security, casual laborers or contractors on which site. It is the process of hiring “some locals” which is valued as important and as a contribution to poverty alleviation. The companies would gain more in the sense of good perception and acceptance for their projects if they were more stringent in the process of providing employment for villagers. This can be interpreted from statements by Soda villagers were very happy with Suzlon, which gave them work during construction and afterwards, while they are utterly dissatisfied with Enercon. In Akal the majority of the men are still not content, even though 20 are employed as security guards. They did not gain employment during construction from either Suzlon or RRB Energy, nor did they manage to convince the companies to use the villagers’ machines during construction.

The PDDs for these projects show that none of the project proponents are under the impression that wind power might have an adverse effect on the people who live in proximity to the projects:

> “Generally the stakeholder comments are invited at the initial stage of the project. Wind energy being an environment friendly process of electricity generation, the project proponent did not envisage any adverse effect on the local stakeholders, instead it was expected to improve the rural infrastructure and bring in socio-economic development in the locality” (Suzlon PDD 2006b:21).

> “Various stakeholders from the above mentioned groups were consulted at various phases of the project from inception to implementation. However the stakeholders raised no concerns as this power project is based on renewable wind resource, harnessed within the region. More over, this project activity also brings various environmental and social developments within the region” (Enercon PDD 2005: 46).

Even though RRB Energy does not recognize that there is a village in proximity to the WEGs, they still claim that the project will: “(...) contribute to the sustainable development of the region, socially, environmentally and economically (RRB Energy PDD 2006: 3).”

The companies claim what Olsen and Fenhann call a tautological argument: “(...) energy projects contribute to sustainable development because they produce energy (2008:2823).” I will also claim that the arguments presented by the wind power companies in their PDDs show that they assume wind power creates a win-win situation for all who are affected by it. The companies equate development with modernization and argue that, by modernizing, there will be an immanent progress of the whole society. Subramanian, secretary general of the Indian Wind Energy Association, also expressed that wind power is beneficial for all. He offered this as his response to the question of whether CDM projects can benefit local people:

> “Most companies who are setting up the wind farms they also take certain responsibilities. You have quoted an instance of roads blocking the water, but there are villagers who got roads because of wind project, which were not connected earlier. (…) Wind again: there is a limited scope of a non-skilled labor being deported in (Recording unclear) …. if there are qualified people in the villages they will take them. This happens in every industry all over the country; be it in steel mills, steel plants, aluminum plants, rice mills. These things get taken care of by the entrepreneurs and sometimes by the government. I'll tell you an example of a wind farm I visited in Kerala. Just two to three weeks before I visited, they said that since commission there are about 20 to 30 new shops that have come on the road which leads up to the project. All selling; Pepsi, cigarettes, biscuits, bread. I mean that has become a picnic site, schools come in batches to see a windmill and go back. All the shops are selling tea, coffee, Coca-Cola, Pepsi. This is brought up the economy of the village; nobody is going to object to it. I mean, it’s about how much of the local people's aspirations can a business meet? And then they have to take it. It cannot be directly, if they ask me to be a mechanic in the wind farm, I'm not capable. I'm not a mechanic.”

Both ecological modernization and sustainable development imply that there is a potential for creating mutually beneficial situations when doing business. The difference between the two approaches can be found in the hierarchy of priorities. Ultimately, the approach of sustainable development puts the fulfillment of primary needs of the poor first. In order to fulfill that primary objective, businesses may have to accept some loss of profits. Only in that way can development, understood as intentional (Thomas 2000), be sustainable.

Ecological modernization, on the other hand, assumes that development is inherent in the modernization process and implies improvement for the whole society. There are therefore no priorities determining which groups within the society should benefit from development. In the case of wind power projects in Jaisalmer, that would entail benefits for all who are affected by introducing an improvement in the overall energy system: i.e., wind power generators. The cases of Akal and Soda villages indicate that the benefits are not equally shared by all; rather, those who are most affected by wind power projects have gained the least.

### 8.3.2 Welfare

Olsen and Fenhann state that it is difficult to limit, categorize and distinguish between sustainable development benefits since they are correlated. This is clear for the welfare criteria. It is difficult to decide how to determine what constitutes a positive contribution to the improvement of local living. Enercon engineers mentioned building infrastructure and improving mobility to and from villages. This can be considered a benefit towards rural upliftment and reduction of traffic congestion. At the same time, the roads which are built in connection with wind power sites have had a negative effect on the welfare of Soda villagers. Based on the indicators, it's difficult to determine if the CDM projects have been beneficial to villagers.

### 8.3.3 Corporate Social Responsibility (CSR)

Suzlon provides medical services to Soda villagers and their animals. The villagers are very happy with this because the medical services are free, and are given on a weekly basis. On the other hand, the villagers of Akal have received minimal medical services from the company. According to them, a medical van with a doctor from Suzlon visited their village twice and performed checkups on people who were not feeling well. They have also received medicines. They have never received medical services from RRB Energy. The villagers expressed that they wanted the same services as Soda village.

Suzlon’s engineer in charge of CDM projects stated that the company considers a village affected by a windmill site if it's within a 5 km radius of the site. Then the village is a candidate for CSR activities such as medical camps and employment. The CSR activities are independent from CDM status. Enercon engineers explained that the company’s CSR policy focuses on building infrastructure.

It is clear that the companies (Suzlon and Enercon) initiate different types of CSR activities for all their projects. The contribution to the villages in form of CSR activities does not depend on the CDM. The CDM has not made a positive contribution towards CSR activities for the villagers. The difference in services between the two villages might be explained by what the companies consider a village. In their PDD, Suzlon refers to Soda village as scattered hamlets, while RRB Energy doesn't recognize Akal village as being within the boundary of the project.

### 8.3.4 Other issues

The farmhouses and land where Akal villagers grow *bajra* are located far away from the village. According to the villagers, Suzlon has plans on making new windmill sites where their farm houses are. The villagers see this both as an opportunity and a disadvantage. It's opportunistic if they can sell their land to Suzlon for a large sum of money, and also be employed during construction. The disadvantage is that they lose their farming land.

For Suzlon it is important to do whatever it can to finish a windmill site on time. The engineer explained that if they have to purchase land from the villagers, then they usually give them any amount of money they want:

> “If the private land is there…. And the cost (of the land) is not more than 50,000 rupees, then these people [villagers] require five lakh rupees for this land. But it’s an urgency basis, so we just give the payment to the villagers. We just give five lakh rupees to the villagers. Otherwise we can’t install our projects on a timely basis. The target is there. If the tower is not installed on that private land; how we can achieve my target?” (Suzlon engineer)

Enercon engineer 2 also mentioned that villagers want money from them or they will block the company's activities in the area. He expressed frustration because the villagers have no ownership of the land where Enercon builds its sites; the company prefers leasing land from state governments because it's cheaper. The company never paid what the villagers wanted; instead, they tried convincing them that they have no claims with the company. Another way of resolving conflicts with villagers was to give them direct and indirect jobs.

The need for keeping the villagers happy was also mentioned by RRB Energy manager: “We must have a good relationship with them or they will stop our cars and tell us that they don’t want our machines there.” Because all three companies mentioned something about “keeping the villagers satisfied” that might suggest that the level of conflict has been higher than what they're willing to admit to.

Responsiveness to stakeholder concerns during the CDM process was essential to giving the entire system input legitimacy. If there is a lack of responsiveness, then participation becomes a mere act legitimizing the prevailing power structures within the system (Lövbrand et al. 2009). Most stakeholders are consulted after the CDM project has been decided upon or, as in the case of Soda and Akal villages, after the project was fully operational. The villagers of Soda were given an opportunity to express their grievances with the wind power projects. Their complaint about the roads built by the companies was noted, but did not result in any action toward correcting the problem. Lövbrand, et al., question this type of participation: “Hence, although procedural rules are in place for local stakeholder participation, the communities directly affected by CDM projects are likely to have less voice in the CDM project cycle than project developers” (2009:86). The practice of “downstream” inclusion of stakeholders might also derive from the opinion of project developers and the industry itself (represented by Subramanian) that wind power projects will create a win-win situation for all participants. When the villagers expressed dissatisfaction with the way the companies let them take part in the benefits of CDM projects, the companies’ response was, in one case, to pay them off and, in other cases, to give them short-term employment. Therefore, it is valid to question the input legitimacy of the three CDM projects in the Jaisalmer area.

The CDM projects have been successful for some of the participants. The state of Rajasthan has benefited from the increased electricity generation from wind power plants, and the area of Jaisalmer has experienced a surge of activities in forms of improved infrastructure connected to the construction of these plants. This means more jobs, but as I've shown in the section on employment and in chapter 5 (on technology) wind power projects require skilled personnel. These are the people getting the long-term jobs. The villagers have benefited to some degree, but the CDM projects have, in the case of Soda, been directly negative for the villagers. Nevertheless, the wind power companies see themselves as a contributor to increased economic growth in the Jaisalmer district, even though their contribution is limited to construction company owners from the city of Jaisalmer. This type of economic growth is not acceptable under the approach of sustainable development where there is a clear understanding of fulfilling the needs of the poor first. Economic growth without the concern for the poorest populations is acceptable under the approach of ecological modernization because it lacks a focus on the social dimension of development.

There is a thin line between the two approaches exemplified by the perception of “locals” in the case of Soda and Akal villagers. The results of a path of ecological modernization can be altered towards sustainable development if the three companies would be more conscientious in their employment practices. This might also increase the input legitimacy of the CDM projects because the developers would show better responsiveness to the stakeholders concerns.

## 8.4 Summary

Suzlon, Enercon and RRB Energy state that their presence in and around Jaisalmer, Rajasthan has contributed to sustainable development. Analyzing the different CDM projects according to sustainable development indicators shows that their contribution has been mostly beneficial for the city of Jaisalmer. The employment practices of the companies during the initial phase has contributed to income generation for the construction industry in the city, while the villagers around the CDM projects feel they have gained little in terms of employment . Wind power requires educated and qualified personnel after construction, and the villagers are not skilled for those jobs. Companies have been attracted to the area due to the state policies and not the CDM. The policies have had a trickle-down effect on job creation, recruitment of educated professionals and development of the energy system. The state policies have been beneficial for the city of Jaisalmer and neglected the poorest in the area. The CDM has not had any effect on increasing access to electricity for the poorest populations because this is the responsibility of the state government.

The practice of hiring local people is valued by the companies as important and as a way of alleviating poverty. But the companies do not differentiate between villagers they hire. The fieldwork showed that this is perceived as negative by villagers. If the companies were more stringent in their employment practices, there would gain more in terms of perception and acceptance for projects. Even so, there is reason to question if the employment opportunities are a result of the CDM. Informants in the companies explained that villagers are hired on a needs basis, regardless of a project's CDM status.

Project developers and the industry itself are under the impression that wind power projects create a win-win situation for all involved stakeholders. Interviews conducted with villagers most affected by wind power projects registered as CDM around the city of Jaisalmer shows that the benefits are not equally shared. The projects fail to contribute to sustainable development for the most vulnerable in that area.

# 9. Conclusion

The Kyoto Protocol is a global agreement dedicated to combating climate change. Under the Protocol, developed countries are mandated to reduce their GHG emissions, while developing countries are expected to benefit from these efforts. Developing countries can participate by hosting CDM projects implemented by developed countries. In that way the latter save on emissions abatement costs, while the former benefit by increased investments in projects contributing to sustainable development. I have argued that the design of the CDM is premised on the notion that actions which lead to overall GHG emission reductions will create a win-win situation for all involved parties. I have also argued that the CDM was an attempt to create a global mechanism which is a fusion between sustainable development and ecological modernization. Both approaches to policy making (Langhelle 2000) support the idea that environmental problems can be solved within the current economic system, and are in line with the market-based design of the CDM. However, the main difference is that the core concept of sustainable development always emphasizes humans and human needs (social justice) over environmental and economic criteria.

The thesis has argued that the CDM is based on a technical-economic understanding of development where technology serves as a vehicle for societal transformation through transfer of marketable ESTs and accompanying policies. In that way the direction of modernization in developing countries can be influenced to avoid negative consequences for the global climate system. Due to the technical-economical definition of development embedded in the CDM, I have argued that the CDM emphasizes the similarities of ecological modernisation and sustainable development. Social justice is overlooked, and economic criteria are valued in majority of CDM projects.

### *Influencing development through policy*

The CDM is a way for developing countries to participate in the global efforts to curb GHG emissions. Participation also enables developing countries such as India to secure technology and investments. At the same time, the CDM can contribute to "the greening of business as usual," or even expansion of an already "green" business sector. The conclusion of this thesis is that the CDM's influence on development of the Indian wind power sector is minimal. This is despite the fact that the majority of CDM projects in India are wind power projects. The Indian wind power sector has developed and become a global market player due to national and state policies designed to attract investors long before the CDM was operational. Even when wind power installations were declining from 2005 to 2008, and CDM participation was soaring, the latter did not contribute to increased installations of wind power in India.

Informants in the wind power companies industry characterized revenue from CDM as "add-on" and "cream on the pudding." Indian wind power developers are not yet convinced that the CDM can generate the same revenue as national and state financial incentives. Interviews with informants show that many wind power projects in India would have materialized without the additional incentives provided by the CDM and CERs. Therefore, there is reason to question if Indian wind power projects registered as CDM satisfy the additionality criteria. Wind turbine manufacturers offer investors (project developers) an all-in-one solution in which the CDM participation is an integrated part. For the wind turbine manufacturers, the CDM is a way of increasing sales of their equipment, while the investors benefit mostly from preferential tariffs and other national/state incentives. The CDM has thus made a slight contribution in influencing the direction of Indian wind power development.

### *Contribution to technology transfer*

By investing in CDM projects which contribute to sustainable development, there was also an expectation that the mechanism would contribute to transfer of ESTs. Informants pointed out that Indian policies for technology transfer were in place long before the CDM was designed. Today the Indian wind power sector has enough capacity to manufacture and develop technology on its own, and therefore opts mostly for unilateral CDM projects. Unilateral projects are a hindrance for technology transfer (Seres. et al. 2008, Dechezleprêtre et al. 2009). Field interviews with the wind power company Enercon, which has a German parent corporation show that the CDM has not increased transfer of higher capacity wind energy turbines. Technology transfer to the wind power companies, Suzlon, Enercon and RRB Energy, has occurred due to past ties with global wind power companies, not in connection with the CDM.

The thesis explores whether the CDM has contributed to diffusion of wind power technology to the state of Rajasthan. The state is a newcomer in terms of wind power development, and has a large untapped wind power potential. It has also captured a substantial share of the Indian CDM market for wind power. However, interviews with informants in the abovementioned wind power companies revealed that it is the state policies of preferential tariffs; affordable and available land; and a decline of high capacity wind sites elsewhere which are attractive to investors. The CDM is presented as one part of the overall investment deal. Investors who can afford the added cost of applying for CDM status have benefited, while the others have been able to take advantage of state policies for wind power. In that respect, the CDM has not made a contribution to diffusion of wind power technology to the state of Rajasthan.

### *Contribution to social development in Jaisalmer, Rajasthan*

Suzlon, Enercon and RRB Energy all claim that their wind power installations in and around the city of Jaisalmer have contributed to sustainable development. These claims are centred on poverty alleviation through increased employment, infrastructure development and increased energy generation. Suzlon and Enercon also engage in CSR activities for those who are affected by wind power projects. Employment practices of the companies during the initial phase of the CDM-projects have contributed to income generation for the construction industry in the city. The villagers of Soda and Akal who live in closest proximity to the

CDM projects feel they have gained little in terms of employment. Wind turbine maintenance can provide long-term employment, but requires educated and qualified personnel. The villagers do not possess these skills. Visits to the wind power sites showed that wind power development has contributed to improvement of infrastructure and access to nearby villages. However, in the case of Soda’s villagers, road infrastructure has had a negative effect on income generation because of detrimental effects on farming. Their grievances have been acknowledged by the companies, but the acknowledgment has not led to a solution of the problem. Local stakeholder participation is a way of increasing input legitimacy of the CDM (Lövbrand et al. 2009), but if the negative effects felt by local stakeholders are ignored then there is reason to question how local participation is accounted for in the CDM.

Hiring “locals” is valued by the wind power companies as an important contribution to poverty alleviation. Interviews with company representatives and villagers showed that the former view the group of “locals” as people who live in and around the city of Jaisalmer. The villagers of Soda and Akal perceive this as a negative development; they lose jobs when companies hire "local" construction contractors from the city. The CDM projects have contributed to a development of the city of Jaisalmer, while those living in the immediate vicinity have not experienced an improvement in their everyday lives. With regards to the previous findings presented in the thesis, it is also questionable if the CDM has made a contribution to development of the state of Rajasthan.

Project developers and the wind power sector itself equate sustainable development with the installation of a renewable energy carrier: i.e., wind turbines. Therefore they assume that wind power will create a win-win situation for all stakeholders. Interviews with villagers affected by wind power projects registered as CDM show that these projects fail to contribute to sustainable development for the most vulnerable in the area of Jaisalmer.

Additionality is a way to ensure the environmental integrity of the CDM and CERs, i.e. guaranteeing global reductions of GHGs. However, this thesis questions the additionality of Indian wind power projects. Indian wind project developers do not see the CDM as indispensible for the project's viability. The whole concept of offsetting industrialized countries GHG emissions through the CDM is thus undermined. The thesis indicates that the CDM has not made a contribution to the Indian wind power sector, nor to the lives of villagers living in closest proximity of the projects.

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# Appendix
## Map of the case study area


Map 1. India


Map 2. Jaisalmer District

The villages of Soda and Akal are located within the red circle

## Official interviews

| **Person** | **Affiliation** | **Date** |
|---|---|---|
| Amit Kumar | Director, Energy – Environment Technology Development Division, TERI | April 6.2009 |
| Viapradas | Senergy Global | April 8. 2009 |
| Suzlon engineer | Suzlon, Jaisalmer | April 16.2009 |
| RRB Energy manager | RRB Energy, Jaisalmer | April 17.2009 |
| Enercon Manager 1 & 2 | Enercon, Jaisalmer | April 20.2009 and April 21.2009 |
| Local RREC official | RREC, Jaisalmer | April 22.2009 |
| Villagers | Soda and Akal | April 23.2009 |
| MNRE-official | MNRE | April 29.2009 |
| Subramanian | InWEA | May 1.2009 |
| RREC official | RREC | E-mail correspondence |