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Renewable Energy and the Clean Development Mechanism in Tamilnadu:

Global Benefits? With Local Costs?

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List of Acronyms

CDM - Clean Development Mechanism
CER – Certified Emission Reductions
CPA – Common Practise Analysis
GHG – Greenhouse gases
GoTN – Government of Tamilnadu
GoI – Government of India
GWh – Gigawatt hour
GWP – Global Warming Potential
IPCC- Intergovernmental Panel on Climate Change
IUCN – International Union for Conservation of Nature
kW- kilowatts
MNRE – Ministry of New and Renewable Energy
MW – Megawatts
NCDMA – National CDM Authority of India
SERC – State Electricity Regulatory Commissions
TEDA – Tamilnadu Energy Development Agency
TNEB – Tamilnadu Electricity Board
TNERC – TamilNadu Electricity Regulatory Commission
UNEP – United Nations Environment Program
UNFCCC – United Nations Framework Convention on Climate Change
WEC – World Energy Council
WCED – World Commission on Environment and Development
WWF – World Wildlife Fund

Abstract

At a time when energy supply is vital for development and reducing emissions is vital for mitigation of climate change, renewable energy comes forth as a possible solution. This paper investigates the Renewable Energy Clean Development Mechanism Projects that have come up in Tamilnadu, India. The impacts on local sustainable development from the projects are evaluated. The Additionality requirements and existence of leakage among the Clean Development Mechanism projects in Tamilnadu are also investigated.

The evidence from the field seems to suggest that some impacts on local sustainable development may be negative. The Additionality conditions seem to be weak given the analysis of the state industry and the existence of possible leakage is found.

Relevance to Development Studies

Enhancing energy supply is a key component for development. The reduction of emissions is critical for global sustainability. This paper investigates the use of Renewable Energy which presents itself as a tool for both objectives. The Clean Development Mechanism provides a subsidy to developing nations to reduce emissions on behalf of the developed world. The impacts of these projects affect the local sustainable development amidst the local communities where they are located are studied.

Keywords

[Clean Development Mechanism, Renewable Energy, Sustainable Development, Tamilnadu]

Chapter 1 Introduction

1.1 Background

The Climate is changing rapidly, untold destruction has been predicted by leading scientific authorities of the world. These climatic changes are largely caused by the increased anthropogenic Greenhouse gas (GHG) concentrations in the Earth's atmosphere. Greenhouse gases trap heat near the earth's surface resulting in the gradual warming of the globe, and hence the name Global Warming. The Global Warming phenomenon is responsible for the melting of the ice caps to the complete destruction of fragile ecological balances causing un-measurable hardships all over the world. From a scientific point of view, a more than 50% reduction in Greenhouse gases is required to stabilise the risk of global warming (IPCC 1996).

The Intergovernmental Panel on Climate Change (IPCC) estimates that more than half the GHG emissions in the world are through Carbon dioxide(CO_2)[1] emissions from fossil fuel use (IPCC 2007:Fig2-1). The Energy Supply Industry is the leading contributor of GHG emissions (Ibid 2007:Fig2-1). The International Energy Agency (IEA) estimates that around 90% of the world's energy is derived from burning fossil fuels (IEA 1998). Energy Demand is estimated to increase by over 50% by 2030 from present levels, as a result of rising population and increasing economic activities mainly from China and India (IEA 2007:3). However despite the fact that China and India are responsible for an increase in energy consumption, the need for future energy sources to have reduced greenhouse gas emissions is a global need. As a result policy strategies that respect both the increasing demand for energy and the need to reduce emissions have emerged.

Renewable Energy presents itself as a possible solution to the contradictory demands of increasing energy supply and reducing emissions at the same time. Although at present it is estimated that only 3% of total energy supply in the world is met from renewable sources (IEA 1998). The IPCC has pointed out that, *"in the longer term renewable energy sources could meet a major part of the world's demand for energy"* (IPCC 1996 in Michaelowa et al 2000:189).

A growing call for more Sustainable patterns of growth and *Sustainable Development* emerged with the report Our Common Future by the World Commission on Environment and Development (WCED 1987). Environmentalists have argued vehemently that current generations were living far beyond the regenerative capacity of the planet. (Cohen 1995) Sustainable Development brings into the notion of development a question of inter-

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[1] Carbon dioxide is one of the six Greenhouse gases specified in Annex A of the Kyoto Protocol.

temporal equity. The needs of future generations and a limit to the growth possibilities of the current generations were highlighted. (WCED 1987)

Climate Change concerns gained prominence in Policy issues notably from the Earth Summit in Rio de Janeiro in 1992 where the United Nations Framework Convention on Climate Change (UNFCCC) came into existence. The UNFCCC was the start of an organised effort to mitigate the impacts of Climate Change. Acknowledging that Climate Change impacts would be felt with regional variations across the globe, the UNFCCC placed a greater responsibility to those countries that had already historically developed and were the main polluters (UNFCCC 1992). Following the UNFCCC, the Kyoto Protocol was adopted in 1997 in Japan. The Kyoto Protocol was an economist's answer to the environmental problem of Climate Change. The costs of reducing emissions were addressed and in an effort to minimise these costs, three flexibility mechanisms were specified in the Kyoto Protocol. These include Emissions Trading, Joint Implementation and the Clean Development Mechanism.

The Clean Development Mechanism (CDM) is the focus of this paper. It brought the participation of developing countries without emission reduction commitments into the realm of emission reductions. The CDM is however subject to a wide variety of criteria that must be fulfilled in-order for the Certified Emission Reductions (CERs) to be meaningful. In the event that any criterion is not fulfilled, the emission reductions cannot be called real. This calls to question the systemic foundations of the market based mechanism in which our faith in Climate Change mitigation lies upon.

A key point of the Kyoto was that the CDM was given a dual objective, to generate CERs and to promote Sustainable Development in the countries where they are located[2]. The Kyoto implies that the impacts from the CDM upon the Host Countries is a pareto improvement from the existing situation. Inherently it assumes that CDM projects will promote local Sustainable Development and at the same time mitigate global climate change.

On the foundations of Weak Sustainability this paper conceptualises the CDM as an instrument to promote Sustainable Development at the Global and Local Level. The CERs generated through the project activity is a measure of the Global benefits from the CDM and the local level impacts on Sustainable Development are varied according to the type of project.

India leads in terms of the number of CDM projects that have undergone certification worldwide. The largest share at almost half of the total projects from India is from the Renewable Energy Sector[3]. Renewable Energy has grown steadily in India, especially in Tamilnadu state where the policies and geographical features were suitable for its growth. The CDM has added to this growth in recent years since.

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[2] Article 12 – Kyoto Protocol

[3] National CDM Authority of India – Website www.ncdma.nic.in

1.2 Objectives of the Study

This paper analyses the Renewable Energy CDM Projects that have come up in the state of TamilNadu, India. Renewable energy is seen as a possible solution to both reducing emissions and promoting sustainable development. The emergence and operation of Renewable Energy CDM projects within the Policy Framework and the Socio-economic ground realities of TamilNadu is the focus of this paper. TamilNadu has seen the development of three forms of Renewable Energy, these are Wind Energy, Biomass energy and Co-generation from Sugar Industries[4].

The paper conceptualises the CDM as bringing forth Global benefits with the possibility of Local benefits as well. Global benefits from the CDM can be measured objectively and quantified in terms of the number of CERs generated from the project. The local level impacts however are not easily measurable and assessment of these impacts involves a level of subjectivity. Nevertheless the actual impacts from these projects are relevant as they affect the people who were least responsible for climate change.

Four Renewable Energy CDM Projects were selected for a field evaluation to investigate their impacts on Local Sustainable Development. The research started with the main objective

To assess the Local Sustainable Development impacts of Renewable Energy CDM Projects in TamilNadu.

But field visits and research data promoted the researcher to modify the main objective of the paper as

To assess if the Global Sustainable Development Benefits from Renewable Energy CDM Projects in TamilNadu are with a Cost to Local Sustainable Development.

The Second objective of the paper was to test various requirements of the CDM within the set of Renewable Energy CDM Projects studied. Wind Projects were tested for their Additionality requirements, Biomass Projects on the existence of Leakage and Co-generation Plants on the effects of the CDM subsidy on the operation of the sugar factory.

The guiding Research Questions for this paper are.

1. Does the Clean Development Mechanism put forth Global Sustainable Development benefits with a cost to Local Sustainable Development in Tamilnadu?
2. What are the Local Sustainable Development impacts of evaluated Renewable Energy CDM projects in TamilNadu?
3. How do Wind Energy CDM projects in TamilNadu perform on an *Additionality* test of *Common Practise Analysis*?

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[4] A brief explanation of each type of Renewable Energy is provided in Annexure 1

4. Is there an existence of Leakage in CDM Biomass Power plants in Tamilnadu?
5. How does the CDM affect the operation of Sugar Factories in Tamilnadu?

1.3 Limitations of the Study

This study covers Renewable Energy projects that are Grid connected and supply electricity either for captive uses or for sale to the State Board.

TamilNadu has a total of 29 Renewable Energy CDM Projects that have completed CDM registration[5]. These include 20 Wind Projects, 6 Biomass projects and 3 Co-generation Projects. Of these four were selected for field visits. The findings from the field visits are not entirely applicable to the whole group of 29 projects.

The analysis of the study leads to findings that are applicable to TamilNadu at due to its location specific advantages and policy environment. Differences in policies across geographical locations limits the use of some findings.

The project evaluations were done with the help of Sustainable Development Indicators that were formulated keeping in mind the Indian Government's Policy on Sustainable Development and characteristics of Renewable Energy in general. The Evaluatory framework used and weights assigned in the Evaluation are based on subjective judgements. Different Indicators and weights used, can give varied results.

1.4 Structure of the Paper

The Paper is divided into 6 Chapters. Chapter 2 gives the contextual, policy related and socio-economic background to the study. It introduces the role of renewable energy, the policy background of the CDM and Renewable Energy in India, at the Central and State level and the Socio-economic setting of the study where Renewable energy has grown in TamilNadu. Chapter 3 covers the central concepts of the paper. Concepts include the *CDM as a Market Mechanism*, *Sustainability, Sustainable Development* and *Indicators for Sustainable Development.* Chapter 4 introduces the four projects selected for field visits and explains the Methodology used. These include the Multi Criteria Analysis used for the evaluation, along with an explanation of the check on Additionality and Leakage. Chapter 5 provides the results of the Analysis and the Findings on the CDM Criteria and Chapter 6 concludes with reference to the research questions and objectives.

[5] All figures and Database constructed was updated as on 1st October 2008.

Chapter 2 Renewable Energy and the Clean Development Mechanism in TamilNadu, India.

The aim of this chapter is to provide the reader with an understanding of Renewable Energy, its advantages in Greenhouse gas mitigation and Sustainable Development, the Policy Background of the Indian State with respect to Renewables and the State agencies that run the Renewable Energy Industry in Tamilnadu, with the socio-economic background of the areas where renewable energy has grown in Tamilnadu. At the end some final statements are provided on the interaction among the Government agencies. An information gap between the Central and State level with respect to Renewable Energy CDM projects in India is identified.

2.1 Renewable Energy

Renewable Energy is any source of energy that is generated from naturally replenishing sources. Conventional sources of Energy such as coal, natural gas or oil takes thousands of years to develop and are under constant threat of depletion. More importantly fossil fuel use releases into the atmosphere carbon stored in them for over centuries that is the main cause of Global Warming.

Table 1.
Comparison of Carbon Emission Intensity from Energy Sources [6]

Fuel	Tonnes of Co²/GWh
Coal	851 – 1362
Oil	733
Natural Gas	367 – 567
Wind	9
Biomass	14

Renewable Energy is self sustaining, inexhaustible and offers a less polluting source of energy. Two arguments form the basis for renewable energy projects being part of a Greenhouse Gas mitigation and Sustainable Development process. Firstly these projects generate energy from a clean non-polluting source, they are in effect meeting a certain demand of energy that would have otherwise been met from a conventional polluting source of

[6] Source – Practical Action - Renewable Energy, Climate Change and Carbon Funding. 2007. The Schumacher Centre for Technology and Development.

energy and hence they contribute towards emission reductions by way of offsetting energy demand from polluting sources. Secondly being renewable in nature these projects builds upon a nations energy assets and contributes to diversification of energy supply, this helps to prevent new fossil-fuel power plants from being created which results in reduced fossil fuel depletion and hence promotes sustainability of its energy resources directly.

Another advantage is that Renewable Energy sources also offer scope for power generation in a dispersed mode and at the load points of the grid, thus eliminating the line loss. This brings better grid stability and power supply in rural areas where Renewable Energy Projects are located (TEDA 2008)

Renewables have had wide political support in the world, especially in light of the emerging consensus over climate change concerns. Authors argue that since the 1990s an *Environment-driven Demand* has developed for renewable energy as a result of the growing concerns with GHG emissions from fossil fuel based energy generation plants. Several Industrial countries responded by intervening in the form of defining minimum quotas for emission free energy, grants, tax incentives for investments and attractive feed in prices per kilowatt hour of renewable energy fed into the grid (Michaelowa et al 2000). Since Renewable Energy has not seen the same amounts of investment into research and development as conventional sources of energy, this has resulted in the need of the various forms of government subsidies to stimulate the growth of renewables in an attempt to achieve market competitiveness with cheaper conventional sources of energy (Ibid 2000). However political decisions to support renewables can prove expensive. To highlight one example, according to the World Energy Council (WEC) German Renewable Energy and Co-generation industries are supported by an annual subsidy of €2.5 Billion and a further €5 Billion per year collected through electricity taxes. Although subsidies of this form are justified to accelerate their development, shielding renewables from competitive pressures can slow down further development of renewable technologies as well as impede the development of other technologies which could be more sustainable in the long run (WEC 2003).

2.2 The Indian Policy Background

The Policy background of India with respect to the Clean Development Mechanism and towards the promotion of Renewable Energy is elaborated starting from the Central to the State level in this section.

The National CDM Authority of India.

The Government of India is both a party to the UNFCCC and the Kyoto Protocol. As required by the CDM, the Government of India established the National CDM Authority of India (NCDMA) as the Designated National Authority of India with the CDM Executive Board in December 2003. The Authority has since been the approving body for all CDM Projects located in India and it checks compliance of CDM Projects upon the aspects required by the CDM Executive Board. The NCDMA undertakes to ensure that the project activity is voluntary participation in the Kyoto Protocol and that the project contributes to Sustainable Development in the country. The authority remains as the single window for clearance in India. And as an Interview confirmed, the assessment of Technical aspects of the CDM such as *Additionality, Baseline Estimation* and *Leakage* are not part of its purview.

The Authority emphasises a "*holistic*" point of view on *Sustainable Development* in its assessment of Sustainable Development impacts from the Project Activity upon the local area and local communities. Project developers are required to submit the Project Design Documents and present how the project fulfils a role in contributing to Sustainable Development in India. Necessary State Level clearances such as from the State Pollution Control Boards are required before final NCDMA approval. Although the authority has not specified any specific indicators for measuring Sustainable Development, It specifies in its website four criteria to which the projects must confirm. These include- Social, Economic, Environmental and Technological Criteria. *Projects that have significant negative impacts upon the local environment and local communities are often rejected* [7]. A total of 1114 CDM Projects have been granted approval in India as on September 2008.

Central Government Incentives and Legislations for Renewable Energy in India

The Government of India has had a proactive role in promoting Renewable Energy through various legislations that put explicit mandates upon State Electricity Regulatory Commissions (SERC) to undertake various reforms in-order to stimulate the growth of renewable energy. The Electricity Act of 2003, The National Electricity Policy 2005 and the Tariff Policy of 2006 are legislations that have elaborated the measures to be undertaken by the SERC [8].

Under the various enactments, the Government of India recognises the role of renewable energy technologies for supplying power to the utility grid as well as in stand alone system. Independent Power Produces are encouraged to set up renewable energy power plants for captive use, third party sale, power trading and distribution. Regulatory Commissions were empowered to specify targets for purchase of electricity from renewable sources as a percentage of the total consumption of electricity. State Electricity Boards are also required to provide adequate measures for grid connectivity and power evacuation to independent power producers. The Central Government Policies also acknowledged that renewable energy would require time before they can compete with conventional sources of energy in terms of cost and so Regulatory Commissions of each state can specify preferential price tariffs for Renewable Energy. Subsequently all major States have announced feed-in-tariff for renewable power and the recent growth of renewable power is attributed to the stable regulatory policy framework. (M.N.R.E 2007:40).

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[7] Source – Interview with Member Secretary, National CDM Authority

[8] Relevant excerpts of the legislations are given in Annexure 2

Incentives offered by the Central Government for investors in renewable energy include accelerated depreciation, Import duty concessions, Tax holidays for ten years and Capital financing at cheaper interest rates[9].

A stipulation from the Ministry of New and Renewable Energy for Biomass plants that is of relevance is that Biomass power plants can co-fire fossil fuels up-to 25% of the total fuel used. This results in Biomass plant owners who are lagging behind in their power generation commitments to the state grid to use fossil fuels such as coal as fuel. The power generated is however at an added environmental cost as a result of the emissions from coal. And as one interview with a senior official of the TamilNadu Energy Development Agency confirmed, "*there is no supervisory mechanism for ensuring compliance that co-firing with fossil fuels does not exceed 25% of total fuel used in Biomass plants"*. Bio-Mass power plants are given a window to protect themselves from shortages in fuel that may arise due to seasonal variations and use coal as a cheap alternative.

Under these regulations, with the incentives offered by the Central Government and the legislative mandates imposed upon them, State Governments set out to promote private investment into renewable energy. The developments that occurred within the State of TamilNadu are highlighted next.

State agencies for Development, Operation and Regulation of Renewable Energy Power Producers in TamilNadu

The State Government of TamilNadu was forced to promote Private Investment into Renewable Energy as a result of the acute power shortages historically faced by the state and the growing calls for less polluting sources of energy[10]. Three government agencies are involved in the development, operation and regulation of the Renewable Energy Industry in TamilNadu, these are the TamilNadu Energy Development Agency (TEDA), TamilNadu Electricity Board (TNEB) and the TamilNadu Electricity Regulatory Commission (TNERC) respectively. The three agencies and their roles are elaborated in more detail below.

TamilNadu Energy Development Agency (TEDA)

The TamilNadu Energy Development Agency functions as the nodal agency of the State with the Ministry of New and Renewable Energy (MNRE) at the Central Government. Set up in 1985 TEDA has among its objectives, to promote the use of renewable sources of energy and to implement energy efficiency and conservation projects.

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[9] A detailed list of applicable Central Government incentives available is provided in Annexure 3

[10] Interview with Senior Officials – TamilNadu Energy Development Agency and TamilNadu Electricity Board.

Since 1986 TEDA was involved in the installation of Wind Farms with Central Government Assistance, the demonstration exercise was jointly undertaken by TEDA and the TamilNadu Electricity Board. Over the period from 1986 to 1993 the agencies set up 19.3 MW of Wind Farms in prime locations in the state. At present most of the primary locations for Wind Farms have been exhausted in the state and TEDA is involved in promoting the secondary locations available in the state which however receive lower wind speeds[11]. TEDA is directly involved in the commissioning of all Bio-Mass power plants (CDM and non CDM) in the state. Applications for Bio-Mass projects have to get a clearance from a standing committee[12] of TEDA which makes a fuel availability assessment for proposed Biomass projects. Only those projects that are within the available capacity of fuel in each district are granted approval. TEDA gives an approval that sufficient Biomass to be used as fuel exists in the area and TEDA directly advises the National CDM Authority on the status of Bio-Mass availability for proposed CDM projects in the state.

TEDA functions to promote renewable energy in the state and as such there is no official policy distinction between CDM projects and non CDM Renewable Energy Projects. Informally TEDA also serves as platform for increasing knowledge of the CDM to the Industry players. As the senior official of TEDA remarked "…*some investors are unaware of the CDM. Some are sceptical and some are optimistic, but all are interested".* The official also remarked that a larger interest in promoting renewables is present within the sector among investors due to the CDM incentive.

TamilNadu Electricity Board (TNEB)

The TamilNadu Electricity Board (TNEB) is the state utility that undertakes transmission and distribution of electricity all over the state of TamilNadu. It forms the market[13] for independent power producers of both renewable and conventional sources. Units of Energy measured in kilowatt hour (kWh) are supplied to the grid and purchased from power producers at fixed rates. The TNEB in its comprehensive power supply strategies provides free electricity supply to many agricultural users in rural areas and this is cross subsidised through higher rates for energy intensive industries in the state[14]. The adequate coverage and uninterrupted supply of electricity at affordable rates form the primary mandate of the TNEB.

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[11] The Centre for Wind Energy Technology (CWET) in Chennai is the main authority on Wind Speed Monitoring and Wind Site Assessment in India. Locations for the State sponsored installation were spread over the high wind areas of the state. Source – Interview TEDA Official

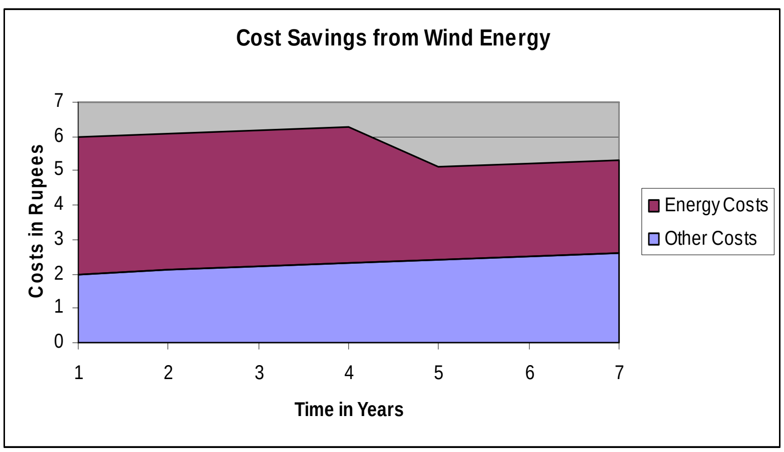
[12] The committee comprises of experts from the Agricultural Board, Industries Board, Electricity Board and among others the Pollution Control Board.

[13] Third party sale of power is only permitted under special circumstances (where the power generation company has a 33% equity stake in the power purchasing company) in TamilNadu and so is rarely used. This results in a single buyer government regulated monopsony situation for electricity in the state.

[14] Source TNEB Website and Interview with Senior Official. TNEB

All Renewable Energy Power Projects execute a Power Purchase Agreement (PPA) with the TNEB for a period of 15 years to 20 years. The TNEB offers to project developers' two options for the power generated in the PPA. The units of electricity generated (in kilowatt hour) are monitored and supplied to the grid. The private company has the option of choosing either to undertake the sale of these units to the Board at a fixed price or to undertake the option of *wheeling*. Wheeling is a concept that was first introduced by the TamilNadu state in India[15]. Choosing the Wheeling option allows companies to utilise, the same number of units generated and fed to the grid, at another location in the state for any use, subject to a 5% wheeling charge of total energy produced. Energy intensive industries have invested in wind energy to reduce energy costs. In addition this insulates the companies from the rising energy costs in future. Within the Wheeling option parties can choose to undertake *Wheeling and Banking* of the extra units or *Wheeling and Surplus Sale* of extra units. Banking allows the company to utilise the energy at another time within one year. Over 65% of the wind mills that have come up in the state through private investment are under the wheeling option (TNERC 2006).

Figure-1
Illustration of Cost Saving through use of Wind Farms for Energy Intensive Companies



Source Based on Interviews with Project Developers and Wind Developers. Both costs are hypothesised as increasing at a nominal constant rate.

In terms of safety regulations the TNEB has recommended a guiding bench mark of 20 to 25 Acres of land required per MW in the case of Wind Farms with use of 225 kilowatt (kW) to 350kW wind turbines. This is arrived at by fixing the distances between each wind turbine as mandated by what is

[15] Source Interview TNEB official

commonly known as the *7D*[16] rule and subject to further minimum safety regulations by the TNEB to maintain distances from roads, sub stations etc. The area of land required per MW decreases with the use of higher capacity machines. Any company undertaking the installation of a Wind Farm must first show proof of ownership of the land upon which the project is to be located.

TamilNadu Electricity Regulatory Commission (TNERC)

The TamilNadu Electricity Regulatory Commission (TNERC) was established to regulate and arbitrate the electricity sector in Tamil Nadu (including both renewables and non-renewables) within a wide set of policy guidelines prescribed by the Central and State governments.

For renewable energy projects the TNERC has set the applicable tariffs, the wheeling charges, the banking charges, power evacuation issues and other related issues to the operation of the projects. Presently the regulatory aspects of renewable energy projects namely Wind, Bio-Mass and Co-generation are defined in the two latest orders by the Commission in 2008 and 2006[17]. The commission issues such orders after having considered draft consultative papers, views of stakeholders, public hearings, views of experts and the views of the TNEB as well. Orders issued are guided by the tariff related provisions of the various acts that encourage adequate support and return to investor.

Under a number of operational assumptions [18] the TNERC has fixed the purchase prices per unit of electricity supplied from Wind, Bio-Mass and Co-generation plants at Rs 2.90, Rs 3.15 and Rs 3.15 per unit for an agreement period of twenty years, subject to a control period of 3 years. The TNERC also fixed the minimum percentage of power procurement from renewable sources at 10% in the state of TamilNadu. For the wheeling option the commission fixed the charges at 5% of energy for Wind, 3% within a 25km usage for Bio-Mass and Co-generation and 6% beyond a 25km usage. The banking option was set at 5% for wind energy available for a one year period from 1st April to 31st March every year after which the banked energy units may be considered as sold. (TNERC 2006). These regulations are comprehensive and cover almost all aspects where investor uncertainty can be present. The TNERC has managed to balance public values and private investor interests to successfully promote Renewable Energy in TamilNadu.

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[16] The 7D rule is a safety regulation that keeps the distance between each wind turbine at seven times the length of each blade.

[17] TNERC regulation on *Power Procurement from Non-Conventional Sources 2008 and 2006*

[18] The Plant Load Factor of Wind Mills is taken as 26%, that of Bio-Mass is 80% and Co-generation is 55%, Capital costs per (Megawatt) MW are 50 Million, 40 Million and 40 Million Rupees Respectively. The Tariff determination for each Renewable type, computed under cost plus method is found in TNERC Order dated 15.5.2006

2.3 The Renewable Energy Industry in Tamil Nadu

This section starts by highlighting the growth of Renewables in the state of TamilNadu in comparison with other states and then provides a description of where renewable energy has come up in the state.

Table-2

State Wise Comparison of Renewable Energy Performance, Targets and Buy Back Rates[19].

State	Installed Capacity of all Renewables in Megawatts (MW)	Buy Back Rates in Rupees per unit (kWh)		
		Wind	Bio Mass	Cogeneration
Tamil Nadu	4445	2.9	3.15	3.15
Maharashtra	1754	3.5	3.43	3.05
Karnataka	1179	3.4	2.88	2.74
Gujarat	875	3.37	3.00	3.00
Rajasthan	519	2.91	3.60	3.60
All India	13729			

As seen from the table above the growth of Renewables in Tamil Nadu has been highest in comparison with other states in India. Its contribution towards installed capacity of Renewable Energy in India is almost a third at 32.3% of installed capacity, far above other states. The Renewable Energy Industry in TamilNadu is mainly from Wind, Biomass and Co-generation from Sugar Industries. The bulk of the growth is mainly due to the growth of Wind Energy in TamilNadu. The growth of these Renewable Energy Sources in TamilNadu are discussed next.

Wind Energy

Currently installed capacity of Wind Energy in TamilNadu amounts to 3903 MW. Wind energy from Tamil Nadu contributes to 50% of the total Wind Energy in India (TEDA 2008:24). The massive growth in Wind Energy in the state is attributable to the high wind speeds in selected geographic areas in southern TamilNadu. The existence of mountain ranges along southern TamilNadu gives rise to three mountain passes which have the highest wind velocities in the state. The Palghat Pass in Coimbatore District, Shegottai Pass

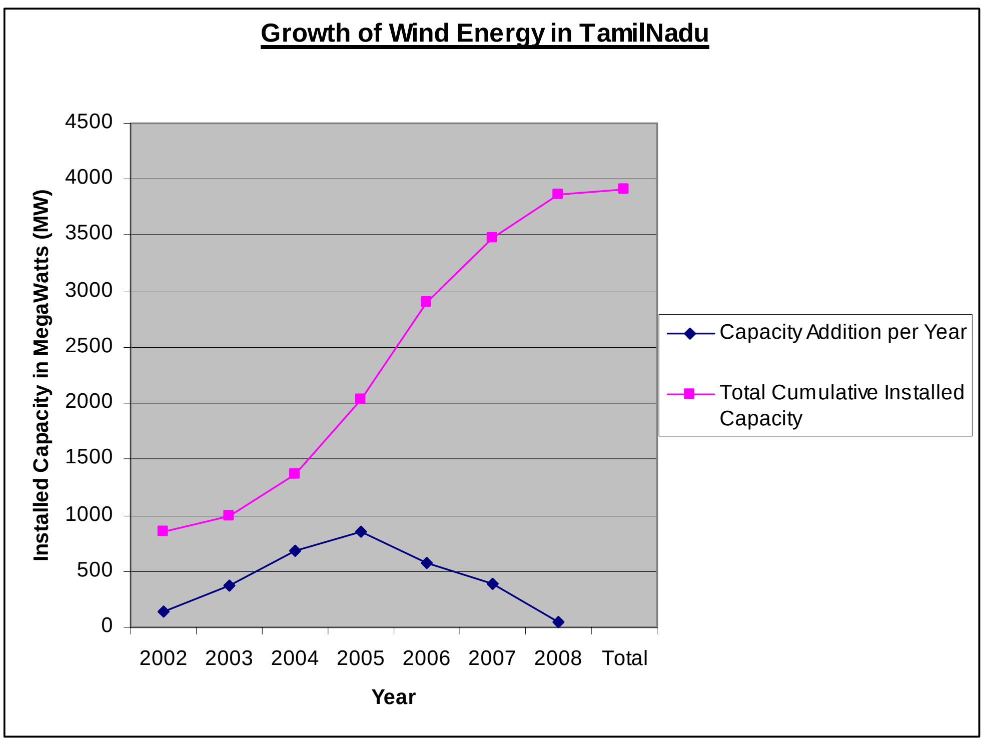
[19] Compiled from Ministry of New and Renewable Energy Website www.mnes.nic.in & TamilNadu Energy Development Agency Website www.teda.gov.in

in Tirunelveli District and Arelvaymozhi Pass in Kanniyakumari District are the three passes where Wind Energy has developed.

Interviews conducted with officials from the Tamil Nadu Energy Development Agency have shown that the Wind Energy Capacity in TamilNadu is almost exhausted in the Primary locations of the three passes mentioned above. These passes are mainly in rural areas of the state, with most of the rural population dependent on agriculture, predominantly rice production. Added to this is the fact that Tirunelveli and Kanyakumari have one of the highest rice productivity figures by district in the entire country. This researcher had the opportunity to visit and evaluate two Wind Energy projects located in Shengottai Pass in Thirunelveli District.

Apart from the initial state sponsored demonstration of 19 MW, the entire growth of wind energy in TamilNadu has been through private investment. The following figure shows the growth of the industry per year in TamilNadu since 2002.

Figure 2 Growth of Wind Energy in TamilNadu



Bio Mass Energy

Biomass power projects have grown in rural agricultural areas of TamilNadu in a consistent manner. The availability and cost of fuel is an important factor that determines the viability power generation from Bio-Mass power plants. Biomass plants create a demand for agricultural residues. The Project visited is located in Thiruvengaivasal Village in Kulathur Taluk in Pudukotai district. Pudukotai District is mainly Agricultural based with 74% of the Workforce involved in agriculture[20]. The district has seen four Biomass plants come up and the demand for Biomass residues for use as fuel gives extra income opportunities to farmers and workers. Patterns of crop production are constantly varying with new techniques, technology and opportunities[21]. Pudukotai district is largely agricultural and the Biomass projects visited for research purposes are located in rural areas of the district.

Bio-Mass studies undertaken by the Ministry of Non-Conventional Energy Sources have estimated the total potential for Biomass energy in TamilNadu as 487 MW of which a total of 99 MW has currently been commissioned and installed[22]. These projects were sanctioned by TEDA based on the Fuel Availability studies conducted.

Co-generation from Bagasse in Sugar Mills

Co-generation plants in TamilNadu have been practising electricity production with the use of Bagasse for their own captive use. The changing scenario where power is demanded by the State has resulted in a favourable opportunity for Sugar Factories to invest in new technologies that produce almost four times the electricity with the same amount of fuel. Electricity produced is used for the factory and the excess electricity produced is sold to the grid. Most Co-generation projects are a part of the existing sugar factory.

TamilNadu has a total of 21 Sugar mills which are having Co-generation plants in operation. The total installed capacity of Co-generation from Sugar is 446 MW. Out of this 256 MW is surplus exported to the grid[23]. Sugar Mills are located in proximity to rural areas with access to sugarcane required for sugar processing. The project visited for study is located in Kurumbur village in Pudukotai District which is a backward area where extensive agriculture is undertaken and 85% of the total work force is involved in agricultural activities[24].

Final Statements

The three Agencies that operate the Renewable Energy Industry in TamilNadu have complimenting roles. The TNERC remains the final authority on setting tariffs and all applicable charges. The TNEB is the market for power in the state, and the grid through which units of electricity is wheeled before consumption. The growth of wind has been strong in TamilNadu due to the

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[20] Source - TamilNadu Census – Relevant Extract provided in Annexure 4

[21] Interview Joint Director for Agriculture – Pudukotai District

[22] The Bio-Mass Assessment Study conducted through Anna University under funding from the Ministry of Non-conventional Energy Sources in 1999 is used by TEDA as the reference for calculating the Bio-Mass availability. One CDM project has shown their Bio-Mass fuel use calculations based on this study in the Project Design Document.

[23] TEDA Website http://www.teda.gov.in/page/sugarmills10.pdf

[24] Source - TamilNadu Census – Relevant Extract provided in Annexure 5

location specific advantage present and the TNERC has been able to exploit this advantage and promote the development of wind energy at comparatively lesser costs than other states. Bio-Mass power projects have come up as well in the state where availability of fuel has been sufficient. TEDA has been at the forefront of the developments in renewable energy, it plays a pivotal role in promoting the wind sites suitable, providing technical support to investors, assessing Bio-Mass availability and acts as the link with the Central Government. The advent of the Clean Development Mechanism has not affected the functioning of these agencies. No projects are differentiated amongst being registered under CDM or not and the State level departments are not aware if projects have undergone CDM certification. This information gap at the State level does not affect the growth of the renewable energy sector, except perhaps to induce investors to delay projects until CDM revenue is assured. Government benefits remain same to all projects and CDM certification is outside the purview of the State agencies. Given that CDM certification is only required from the National CDM Authority of India, state level agencies have no role in the CDM process for projects. The State level agencies however are the regulatory and operational mechanisms within which all Renewable Energy projects in the state function.

Chapter 3 Conceptual Framework

This chapter provides an introduction to the three main concepts that are central to this paper. The concepts are briefly explained and further elaborated with a review of literature to highlight the relevant theoretical underpinnings of each. The three concepts explored are

1. Market Mechanism – Clean Development Mechanism
2. Sustainability and Sustainable Development
3. Indicators for evaluation of Sustainable Development

3.1 Market Mechanisms – Clean Development Mechanism

A Market can be described as a system of resource allocation based on monetised exchange. Efficient allocation of resources by a market system requires Neo-classical assumptions of perfect competition, complete information and well defined property rights (Stiglitz 2005). Further as Rhoads argued, *free markets with flexible prices coordinate the activities of millions of people in different countries in a remarkable way.* (Rhoads 1985:64). This *invisible hand of the market* it was assumed would always lead to an economically efficient outcome in contrast with institutional arrangements such as government intervention and regulation. This assumption derives from Neo-liberal arguments. (Gamble 2001:127-34). In addition markets are constantly evolving, with their boundaries being redefined constantly (Gasper 2002).

But as authors point out, the Neoclassical assumptions required for efficient functioning of markets are very often unrealistic. (Dubnic and Bardes 1983:43). The non-fulfilment of any of these required conditions gives rise to what is referred to as a *Market Failure*. Furthermore Market based approaches take for granted an interpretation of consumer sovereignty which weighs people's wishes according to how wealthy they are (Gasper 2002).

Market Mechanisms in the context of Climate Change – Emissions Trading

The environment is one realm where the market mechanism has seemingly failed to allocate resources efficiently. Authors argue that the lack of well defined property rights leads to over consumption and what is called as the *Tragedy of the Commons* (Varian 1999). The allocation of pollution rights to all parties, with the option of trading in these rights is offered as the solution. This trading of pollution rights is what is known as Emissions Trading. Emissions Trading, it is argued leads to a Pareto optimal outcome enabling environmental compliance at efficient prices (Tietenberg 2001).

The Logic of Emissions Trading

Emission Trading schemes is based upon the existence of a *cap and trade* model where each polluter or party to the emissions trading is allocated an assigned quantity of pollution permits or quota for emissions within a specific time period. Three basic scenarios can arise upon the implementation of such a scheme.

Firstly a polluter may use up his entire allowance of permits in the allocated time period, but manages to limit pollution to the regulated amount. He remains in compliance and does not undertake trading in this scenario. Secondly a polluter may use up his entire allowance of permits in the allocated time period but still pollutes more, hence to remain in compliance he has to purchase permits from another polluter who has not used up his whole allotment. Thirdly a polluter may not use up his entire allocation of permits in the time period. He is now in a position to bank the credits for use in future periods or sell the credits to another polluter who requires them.

Under the Kyoto Protocol with the existence of the Clean Development Mechanism there is another possibility for the polluter that has come up. This includes the option where the polluter can invest in pollution reduction schemes in other countries and earn credits from these projects. These credits can then be sold, banked or used to make up shortfalls in the original allowance.

The Clean Development Mechanism

The Clean Development Mechanism allows project activities that reduce emissions to be implemented in developing countries that are not bound by emission reduction commitments. The CDM has been compared to a subsidy, a market and a political mechanism (Wara 2006). It is a subsidy in that it pays developing countries to reduce emissions, It is a market in the sense that it has created a currency of Certified Emission Reductions and it is a political mechanism because it has already brought developing countries into global participation with the struggle against Global Warming and forges a new form of interaction between Developed and Developing Countries.

History and Origin

The CDM was conceived from the original idea of a Clean Development Fund put forward by Brazil in the Kyoto Negotiations in 1997. It was based on the idea of financial penalties for non-compliance by developed countries which could be used for climate change adaptation. The idea of financial penalties was however opposed vehemently and in the end instead of there being a penalty for non-compliance the nature of the proposal changed into that wherein investments could be made to help achieve compliance. And so from the idea of a development fund it became a mechanism for investment by private companies into project activities that reduce emissions and contribute to sustainable development. (Grubb et al 1999).

Purpose

The CDM as put forth in Article 12 of the Kyoto Protocol has a dual objective, to generate Certified Emission Reductions (CERs) that will help achieve compliance with emission reduction commitments and to promote Sustainable Development in the countries where they are located.

The Kyoto implies that what is good for the global environment is good for the local development opportunities in developing countries. However as many studies show trade offs exist between the two objectives of the CDM. Sustainable Development is often overlooked in favour of cost effective reductions of greenhouse gases. (Markandya and Halsnaes 2002, Sutter 2003). These authors argue that the CDM has a tendency to attract investment into those projects that have the least carbon abatement costs with little regard for Sustainable Development objectives.

Authors argue that from the sustainable development perspective the CDM does not work, in that it does not drive Sustainable Development in Host Countries through projects that have high investment and development benefits but chooses least-cost abatement projects. (Driesen 2007) Others argue that unfortunately the CDM has demonstrated that it works perfectly, it produces the cheapest emission reductions that have a monetised value and left out of the market forces are the sustainable development benefits. They highlight the need that the mechanism should be able to place a monetary value on the contributions to sustainable development and only then can investments be directed towards those projects that have higher sustainable development benefits. (Sutter 2003, Olsen 2003)

Issues in Fundamental Design

The CDM differs from previous emissions trading programs in the key aspect that it is not a Cap and Trade system because the Host Countries (non Annex I Countries) where CDM projects are implemented have no binding cap on their emissions. This provides the incentive to artificially inflate the baseline while quantifying the emission reductions.

Another aspect of the CDM that adds complexity to its fundamental design and operation is that it is the first emission trading program that covers multiple Greenhouse gases and allows conversion between these gases through the medium of a single currency from the CDM, the Certified Emission Reductions (CERs) (Wara 2006). CERs are quantified in terms of the Greenhouse gas abatement in tonnes of Carbon dioxide. Each registered project activity under the CDM is allocated an averaged annual number of CERs expressing an estimated equivalent reduction in Greenhouse gases for the duration of the project.

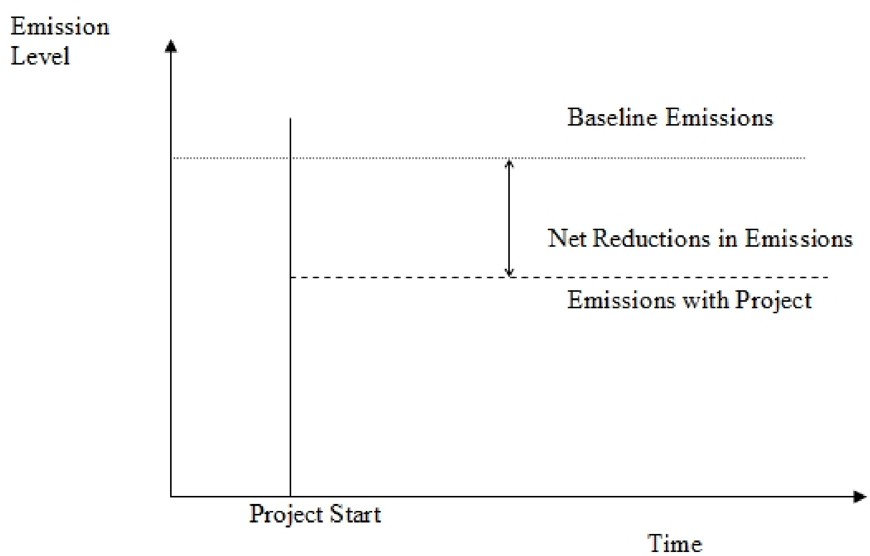
The CDM operates through an expansive project cycle within an elaborate organisational setup. Although not directly concerned with the research objectives, a brief explanation of the CDM's organisational setup and project cycle is provided in Annexure 6.

Relevant CDM Criteria

Setting a Baseline

All CDM projects have to demonstrate with the help of an appropriate Methodology as specified by the UNFCCC, the Emissions that would have occurred in the absence the Project Activity. A hypothetical baseline against which the emission reductions from the project can be measured must be constructed. This constructed baseline forms the emission scenario in the absence of the CDM project. The CDM project results in emission reductions from the baseline, but the project can also cause new emissions. Hence the net reductions in emissions as a result of the CDM project activity are quantified as CERs. The below figure is a representation of a baseline scenario of emissions and the emission reductions as a result of the CDM project.

Figure 3 Illustration of Baseline Emissions



Source Own Construction based on UNFCCC documents

The tendency of the Project Developer is always to inflate the baseline to maximise the net reductions and thus increase the number of Certified Emission Reductions from the Project. This results in the creation false reductions that never occurred. Baseline evaluations remain prone to manipulation with an incentive for cheating.

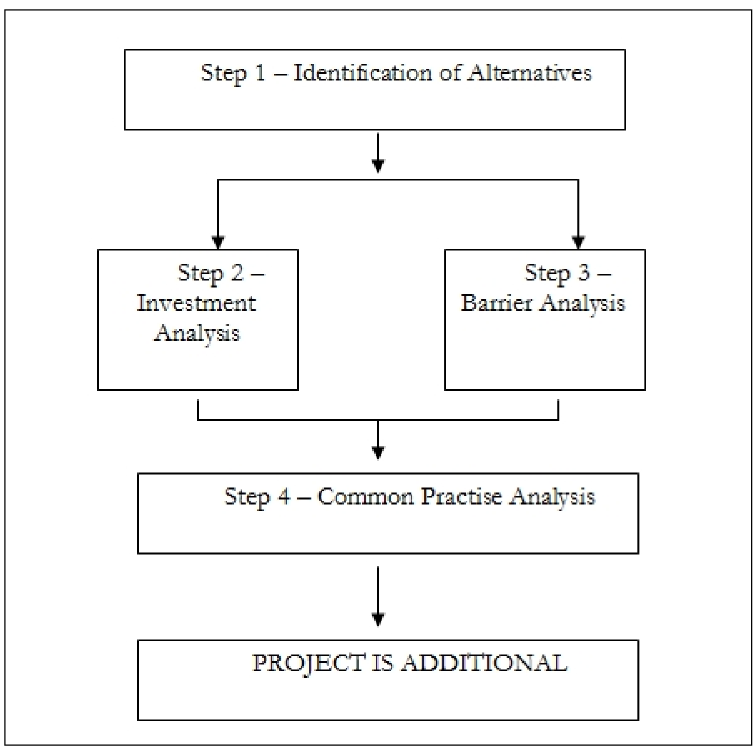
Additionality

The Additionality prerequisite remains a point of contention within the aspects of the Clean Development Mechanism. All CDM Projects have to be *Additional*, this means that a project should not have been a *Business as Usual* proposition that would have anyway been undertaken anyway by the developer. Project Developers must demonstrate the Additionality of Projects through the prescribed Methodological Tool[25]. In short Project Developers have to show that unless the CDM benefits existed the Project would not have come into existence. This means that there exists a need to screen out those projects that arise from a Business as Usual scenario and consider only those that are additional for CDM registration.

The Additionality clause also gives rise to perverse policy incentives, as elaborated *Environmentally sustainable projects are least likely where the policy environment is least encouraging. Hence Additionality is easiest to prove in the worst policy environments.* (Grubb et al 1999:229) Grubb argues that the CDM places on National Governments the incentive to refrain from tightening environmental standards as this would negatively affect the growth of CDM projects in the country.

A simplified re-creation of the flowchart for proving Additionality is given below in Figure 4 followed by a brief explanation of each step.

Figure 4 - Steps for Additionality



[25] Relevant extracts from the Tool for Demonstration and Assessment of Additionality is provided in Annexure 7

Explanation of the steps

The project must first define plausible alternative scenarios that could have been undertaken in the absence of the CDM activity. This includes the proposed activity undertaken without being registered as a CDM project activity and other realistic options that the project developer has.

Next the Project developer can show through an Investment Analysis that the CDM Activity is not the most financially attractive option available among the alternatives defined. He must also show that without the revenue from sale of CERs the project is not feasible. For Renewable Energy Projects this is commonly done with the help of a benchmark against an established Industry rate of return and a Sensitivity Analysis.

Alternatively the Project can choose to undertake a Barrier Analysis to show that the proposed CDM project faces barriers that prevent the implementation of this type of activity and the barriers do not prevent at-least one of the alternatives identified from coming to existence.

Following this, the next step for assessment of Additionality is through what is called the Common Practise Analysis (CPA). The CPA tries to analyse the extent to which similar activities to the project activity has already been diffused into the same region. If similar activities are occurring widely, then it questions the Investment Analysis and Barrier Analysis conducted.

Additionality Concerns for Renewable Energy CDM Projects

With every kilowatt hour of electricity produced, renewable energy technologies can replace emission-intensive energy sources. The implementation of renewable energy projects under the CDM framework is bound by the need to balance the commercial incentives of private actors and the additionality requirement to ensure that projects are beyond what would have happened anyways in a business as usual scenario. The decision as to whether created entitlements are additional or not requires the creation of a hypothetical baseline against which the reductions can be measured. As a result of the interaction of different policies, government incentives, subsidies and income sources in the Renewable Energy Sector, the creation of this baseline and analysis of the motivational structure behind each project remains unclear (Michaelowa et al 2000). This leaves the check on *additionality* for renewable energy CDM projects complicated to analyse and a debatable issue.

Leakage

The process of Quantifying Emission Reductions is also affected by *leakage* in the project activity. Leakage refers to emissions that occur due to the Project Activity. The presence of leakage causes a reduction in the Certified Emission Reductions from CDM projects. Leakage Emissions must be reduced from the total emission reductions of the project to arrive at the net emission reductions achieved.

To give an example, Biomass projects may result in an increase in emissions from fossil fuel combustion or other sources, due to diversion of biomass residues from its original uses as a result of the project activity. Hence the use of non-surplus biomass is a potential source of leakage. Biomass project developers must demonstrate that leakage is absent by any of the following ways[26].

1. Show that the biomass residues used would have been left to decay or burnt without energy production in the absence of the CDM project.

2. Demonstrate that there is abundant surplus of Biomass residues in the region.

3. Demonstrate that suppliers of Biomass in the region are unable to sell all of their biomass residues.

4. Demonstrate that the alternative users of the Biomass residues have fulfilled their needs with the use of other biomass residues and not with fossil fuels.

Biomass has to be transported (usually in trucks) to the project sites. This results in vehicular emissions that have to be quantified and accounted for. The Projects must specify a radius of 20 to 200 km within which the Biomass used is collected. The region specified for Biomass collection must not be changed during the crediting periods. The emissions from transporting the Bio-Mass are also considered as leakage.

3.2 SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

The era of Development has seen a paradigm shift from the pursuit of Economic Growth to that of Growth with an Environmental Balance. Whereas previously environmental concerns occupied more of a back seat in comparison with the development agenda, nowadays development strategies are being re-conceptualised with environmental and ecological concerns embedded within the agenda of growth. This change in approach put forward the two interrelated concepts of *Sustainability* and *Sustainable Development* that has been explored with great interest in the recent academic debate.

Sustainability

History

Sustainability as defined by the International Union for Conservation of Nature (IUCN) report *Caring for the Earth* in 1991 refers to

> A characteristic of a process or state that can be maintained indefinitely. (IUCN, UNEP, WWF 1991:210)

It also defined *Sustainable Use* as the

[26] Relevant extracts on Leakage Assessment from UNFCCC guidelines are given in Annexure 8

> Use of an Organism, Ecosystem or Renewable Resource at a rate within its capacity for renewal. (Ibid 1991:211)

A key element of the concept of Sustainability from the above definitions is that it implies an economic growth pattern with an environmental balance that allows the model of development to be maintained continuously without the risk of depletion of natural resource systems. However as Sayer and Campbell argues, *Sustainability as traditionally used by Natural Resource Scientists implies maintaining a status quo. A focus on the sustainability of particular farming systems means locking farmers into those systems.* But as they demonstrate, natural resource systems are constantly fluctuating and this inevitably results in changes that have an impact on sustainability. Further they argue that there is a need to recognise the possibility of *multiple 'sustainable states' that may involve people switching to entirely new ways of life* (Sayer and Campbell 2004:39). It is however relevant to note that Sustainability as a concept covers many aspects such as Strong and Weak Sustainability and Variations in the applicability of the concept over Scale.

Strong and Weak Sustainability

The distinction between types of capital stocks has lead to a conceptualisation of strong and weak sustainability. Economists differentiate between Capital Stock as being Human-made Capital and Natural Capital. Natural Capital is *any naturally provided stocks such as fertile land, crude oil, forests, fisheries, biomass and the earths atmosphere.* (Perman et al 2003:90). Human-made capital can however be conceptualised as the total of Physical, Human and Intellectual capital stock (Ibid 2003:91) Others however draw up additional classifications such as Social Capital and Financial Capital (Sayer and Campbell 2004:216) For the use in this paper we differentiate only between Natural Capital and Human-made Capital. Natural Capital originates from Nature and Human-made Capital is the sum of the various other forms of capital that are created through human activities.

From the concepts of Natural and Human Capital, Economists and Ecologists debated the limits and meaning of Sustainability. Broadly speaking Strong Sustainability requires that levels of Natural Capital be non-declining, while weak sustainability proponents require that the sum of Human-made and Natural Capital be non-declining. Inherent in this distinction between Strong and Weak Sustainability is the assumptions of inter-comparison and substitutability between different forms of capital. Capital stocks must be expressed in common monetary values and different forms of capital must be able to be substituted for each other. While Strong Sustainability argues that substitution possibilities between Natural and Human-made Capital must be limited, Weak Sustainability calls for greater possibilities to substitute between Natural and Human-made capital in an effort to keep the total value of the combined capital constant. Under weak sustainability conditions, depletion of Natural Capital may be compensated for by investment into other forms of capital. (Perman et al 2003, Sayer et al 2004)

Weak sustainability does not address many crucial concerns of Sustainable Development, the most prominent of which is that some components of Natural Capital are unique and that their loss has uncertain and potentially irreversible effects on human wellbeing. It is in this regard that further concepts of Safe Minimum Standards for maintaining critical levels of Natural Capital and Daly's rules for Strong Sustainability came about[27]. (Bishop 1978, Daly 1990 in Markandya et al 2002)

Applicability by Scale

Sustainability of Natural Resource Systems can change over time and space. The natural system has multiple scales of interconnected interaction and response. Hence as a result Sustainability can vary across temporal scales and spatial scales (Sayer et al 2004).

Temporal scales of Sustainability refer to the fact that different processes take place at different speeds. Some processes and their impacts may be studied over short time frames while others may take decades (Ibid 2004) This revelation is monumental in addressing climate change, most of our actions cause impacts to which humanity only wakes up much later.

On the spatial scale we can acknowledge that impacts on sustainability are spread over a range that stretches from the Global to the Local. Very often adaptation measures that result as a consequence of a negative sustainability impact are spread over different levels of regional organisation. (Ibid 2004). At the Global level it would be safe to say that Sustainability is a required minimum for continued human life without a decline in welfare over time. If Global Sustainability is at risk, then human existence is at risk. The concerns over Climate Change are in effect a concern for Global Sustainability. At the local level Sustainability is difficult to quantify due to the interlinked nature of natural and economic systems, Sustainability strains caused by any activities result in adaptation that may or may not result in a sustainable outcome. Further as Sayer points out fragmented analysis over extremely small scales may be meaningless when it comes to tacking bigger problems of both local and trans-local nature. (Sayer et al 2004:84)

Sustainable Development

History

The term *Sustainable Develop*ment had its origins in the *World Conservation Strategy Report* by the International Union for Conservation of Nature (IUCN 1980). However the term Sustainable Development gained prominence from the well known definition in the report *Our Common Future* by the World Commission on Environment and Development (WCED 1987). Also known as the

[27] Safe Minimum Standards imply a level below which Natural Capital must not fall to allow ecosystems to remain viable. Daly's rules for Strong Sustainability include - A harvest rate at or below the growth rate for renewable resources, Developing Renewable substitutes as non-renewable resources are depleted to maintain the flow of services over time and Limiting Pollution Emissions to the assimilative capacity of the environment. (Markandya et al 2002:31-34)

Brundtland Report the WCED put forward a definition of Sustainable Development as

> "…development that meets the needs of the present without compromising the ability of the future generations to meet their own needs… It contains within it two key concepts - the concept of 'needs' in particular the essential needs of the world's poor, to which overriding priority must be given; and - the idea of limitations imposed by the state of technology and social organisation on the environments ability to meet present and future needs." (WCED 1987)

Central to this definition is the prioritisation of the needs of the people. Equity is explored from an intergenerational as well as intra-generational perspective. The vast needs of the present generation are fulfilled in limitation to the extent of the environment and the state of technology present. One assumption inherent in the definition is that future generations can benefit more with better technology. Nevertheless it implies an inter-temporal trade off in consumption and places a responsibility on present generations to preserve the environment so that future generations may also utilise the environment for their needs.

A lesser used definition of Sustainable Development came from a report in 1991 titled *Caring for the Earth - A Strategy for Sustainable Living*. The report defines Sustainable Development as

> Improving the quality of human life while living within the carrying capacity of supporting ecosystems. (IUCN, UNEP, WWF 1991: Pg 211)

The IUCN definition comes across as that of Development with an Ecological approach towards growth. A level of strong sustainability comes across from the IUCN definition as seen from the importance attributed to human existence while extracting at a rate equal to or less than the rate of growth of Natural Capital. The WCED definition however implies a higher degree of Weak Sustainability. The idea that limitations are imposed by the level of technology and social organisation reflecting the possibility that improvements in technology will lead to improvements in efficiency and better substitution possibilities.

An Economic Consumption Perspective on Sustainable Development

As Sustainable Development concerns incorporated the needs of people over future generations as well, early economic approaches incorporated consumption patterns over present and future time periods and tried to arrive at suggested patterns of growth that would maintain or increase consumption possibilities over time. (Atkinson et al. 1997). Further as Solow argues that future generations will not be interested in the natural resources that we leave them as much as they will be interested in the production and consumption capacity that will inherit from the present generations (Solow 1986 in Perman et al 2003). These arguments imply a high level of assumed substitutability and follow in line with the principles of weak sustainability discussed earlier.

Aligning the concepts and theory

This paper conceptualises Sustainability and Sustainable Development as interrelated concepts that merge together given the nature of the CDM. To generalise on a broad conceptual level Sustainable Development leads to higher levels of Sustainability and any level of Sustainability implies a degree of Sustainable Development. While Sustainable Development can be seen as a dynamic process over time which results in outcomes, Sustainability lends itself as a measure of Sustainable Development at a single point in time. Both concepts bring in the element of the future, both try to address the generations yet to come that will demand the same resources of this planet. Sustainable Development tries to achieve this by way of contributing to the stock of Natural Capital or by reducing the rate of depletion, while Sustainability indicates if the current pattern is one wherein a net depletion of Natural Capital is happening. Sustainable Development brings a meaning of evolution and adaptation and can be seen as a means while Sustainability is seen as the desired end.

3.3 SUSTAINABLE DEVELOPMENT INDICATORS.

For the purposes of the evaluation of the projects selected, Indicators were chosen to assess the Sustainable Development impacts and the contributions to Sustainability from the CDM projects. In order to assess if the Global sustainable development benefits through Certified Emission Reductions are achieved with a cost to the Local level, the impacts on Sustainability and Sustainable Development from these projects at both levels must be analysed. As conceptualised the evaluation was one to assess the Global and the Local level contributions from CDM projects, requiring appropriate indicators to be framed.

Meaning of Indicators.

The purpose and logic of the Indicators used are briefly explained here. The purpose of each indicator is to assess the impact or outcome from the CDM - project with respect to a desirable or undesirable end-result seen from the CDM project. All projects have varied impacts on Social, Economic and Environmental criteria and the indicators serve to inform if the impacts are positive or negative and if so to what extent.

In addition all indicators are measured in relation to the baseline scenario, this is keeping in line with the CDM requirements that all emission reductions must be additional to what would have happened anyway. The impacts from the CDM project are given scores for the directly attributable impact from the project activity. It follows logically that each impact would have been absent if the project had not been undertaken.

As discussed Indicators were specified at the Global and the Local Level. All indicators are given a score ranging from -2 to +2. A score of -2 means a major negative contribution from the project towards the indicator from the baseline, while a +2 means a significant positive contribution from the CDM and a score of 0 implies no change from the baseline scenario. The scoring system used is explained more in Chapter 4.

Global Level Indicator

All CDM projects are conceptually seen as contributing to Sustainability at the Global level by reducing GHG emissions. The global level indicator is based on the assumption of weak sustainability that Human-made capital can substitute for Natural capital. In the context of the CDM the project activity is basically reducing the rate of depletion of the Natural Capital. Each CDM project is validated and certified for the estimated emission reductions it undertakes to perform. The indicator values are got from the Project Design Documents of each project activity. It is of note that the Global Indicator essentially is a measure of private benefit, as the returns from CERs accrue to the project developer.

1. Quantum of Certified Emission Reductions – CERs

At the Global Level, the quantum of CERs generated from each project activity was taken to be the measure of Sustainable Development through the CDM project towards Global Sustainability. This indicator is expressed in tonnes of Carbon dioxide and represents the tonnes of Carbon dioxide emissions reduced through the project activity. The CERs generated have a monetary value and project developers undertake CDM projects for the revenue from the sale of CERs. A final point of relevance is that all CDM projects will by definition have a positive Global level indicator as all CDM Projects perform emission reductions.

Local Level Indicators

Local level indicators were chosen based on three of the four accepted dimensions of Sustainable Development as recognised by the National CDM Authority (Social, Economic and Environmental). The local level indicators measure the extent of the impacts from the CDM project upon the stakeholder, local communities and the people affected by the CDM project. The choice of indicators was finalised through the help of previous CDM project evaluation studies and keeping in mind the characteristics of renewable energy in general.

Social Indicators

1. Poverty Alleviation from Project Activity – Critical Indicator

The directly attributable effect of the CDM project towards poverty alleviation is assessed. This indicator is considered a critical indicator as suggested by (Kolshus, Vevatne et al 2001 in Olsen 2007). A minimum condition is that this indicator must be neutral or positive. A negative score would mean increased poverty as a result of the CDM Project.

2. Impact on Equity - Redistribution of Capital (Income / Land) – Hot Indicator

The CDM project must also try to ensure that it has a positive redistribution effect of Capital upon the local communities in which the project is based. Capital includes Land Ownership, Rents and Income Sources. The impact on Income Sources and the ability to maintain extracting economic rent from Land form part of this Indicator. This indicator is not be critical but has a high degree of relevance socially. This indicator is important because in effect an Equity Judgement on the Project activity is made. A point to note is that in case this Indicator is negative, further investigation is relevant.

Economic Indicators

3. Jobs Created (Types and Numbers)

The Jobs created directly as a result of the CDM project are given a score based on the number of jobs created and the types of jobs created. A preference is given to creating jobs that employ skilled and technical persons. Usually this indicator is positive as CDM projects generate a net increase in Jobs. Some CDM projects that replace outdated technology can also have a net reduction in jobs.

4. Output Forgone – Value-Judgement Indicator

CDM projects result in Certified Emission Reductions either by undertaking a new activity or by modifying an existing activity. In some cases the previous economic activity is no longer feasible or possible as a result of the CDM Project. The benefits from the CERs may still be greater than the output forgone. Nevertheless the output lost finds relevance if the nature of the activity stopped is essential for Local Sustainability and Sustainable Development. A positive score here implies that something of no use previously or that which would have been discarded is now being used productively.

Environmental Indicators

5. Impact on Local Environment.

The direct impact of the CDM project on the local Environment (Air, Water and Soil) and towards maintaining the Sustainability of the Natural Resources in the area is assessed. A major negative contribution must be considered as critical since local communities are adversely affected in such a case. Renewable Energy projects usually have a low impact on the local environment.

6. Increased Energy Production Capacity from renewable & non polluting sources

The installed capacity of each renewable energy project is considered as an environmental benefit as opposed to an economic indicator. Since the energy generated is both non-polluting and each project promotes reduced fossil fuel depletion, displacing future demand from polluting sources, each project is given a score based on the installed capacity of the project.

Chapter 4 Projects Evaluated and the Methodology Used

This Chapter introduces the four Projects selected for field study and explains the methodology used for the study. First a brief introduction of each of the projects evaluated along with the reasons why these projects were chosen for field investigation is given. Next the Evaluatory Framework constructed with the indicators and their weights in each criteria are explained. The methodology employed for deeper investigation of Indicators 2 and 4 is explained as well. The tests on Additionality and Leakage from the Renewable Energy CDM projects in TamilNadu are explained next. The excel database created is explained, the interviews conducted are elaborated and lastly the review of literature conducted is highlighted.

4.1 Projects Selected for Field Visit

Ashok-Leyand Wind Energy (AL Wind) - 56.25 MW

The CDM project is a large scale[28] wind energy project with a total installed capacity of 56.25 MW. The project is located in two districts of TamilNadu. The project sees the installation of 26.77 MW in Tirunelveli district and 29.47 MW in Coimbatore district. It uses basic technology wind turbines of 225kW capacity and in terms of TNEB guidelines the project takes up an area of roughly 1400 acres. The power generated under the project is supplied to the grid and wheeled for captive use by the same company. The project with an expected lifetime of 25 years commenced operations from 2002. The project demonstrates *Additionality* with the help of a financial analysis showing the low Internal Rate of Return from the project in comparison with an industry benchmark of 16%.

Emission reductions from the project activity are equated as the baseline emissions for a given year had the same quantity of electricity generated come from the grid. The Baseline emissions are calculated as the product of total Electricity generated with the Baseline Emissions Factor. The Baseline Emissions Factor can be understood as an estimate of carbon intensity of the overall electricity supplied to the grid measured in tonnes of Carbondioxide per Megawatt hour (tCO_2/MWh). It is calculated based on their respective carbon intensities and percentage contribution of each energy source such as Coal, Lignite, Gas and other thermal plants to the grid.

Baseline Emissions = Electricity Generated X Baseline Emissions Factor

tCO_2 MWh tCO_2/MWh

[28] In the CDM Large Scale Projects are those with a total installed capacity of more than 15 MW. Small scale projects have a capacity of less than 15 MW.

The project has a calculated baseline emissions factor of 0.83 tCO_2/MWh. Put differently, this means that for a full production year with a net electricity generation of 100,000 MWh units, 83,000 tCO_2 reductions are achieved. In total the project gives rise to an estimated total reduction of 329,685 tonnes of CO_2 over the first seven years[29]. Thus the carbon credits generated are directly related to the amount of electricity generated and to the emissions factor. An increase in electricity produced results in more energy displaced and thereby more CERs. However, with respect to the Emissions factor, in a manner of speaking, the dirtier the Grid, the higher the Emissions Factor, leading to more CERs.

The project developers have opted to assume the risk of issuance of CERs and have not gone in for any futures sale contracts. This shows the ability of the developer to assume market risk, a degree of financial stability in the project and confidence of the party in executing the project satisfactorily.

Indowind Energy – 12.3 MW

This small scale CDM project activity is located in Tirunelveli District and undertakes the installation of a total of 52 wind turbines of 225kW and 250kW capacity adding up to a total installed capacity of 12.3 MW. The units of electricity generated are used for both wheeling and sale. About 60% of the power is sold to the TNEB Grid while 40% is used for captive purposes by the company. The project takes up approximately 275 Acres of land spread over three villages with over half the project located in Pazhavoor village which is predominantly agricultural. The same methodological arguments are used by the Project Developer for proving additionality as the large scale wind project. The return on investment is shown to be unattractive without the CDM benefits against an industry benchmark rate of return and the existence of barriers to the project are demonstrated. The Baseline Emissions Factor calculated is more conservative than the large scale project at .79 $kgCO_2/kWh$[30]. The project developer has also taken full risk of CERs and not committed the sale of the CERs. The project has estimated emission reductions of 100,912 tonnes of CO_2 over the first seven years.

Chitra Bio-Energy – 7.5 MW

This small scale project is located in the Agricultural District of Pudukottai and utilises Biomass residues in the region for use as fuel in the power plant. The main forms of biomass used as fuel include Prosopis Juliflora, Coconut Residue and Groundnut shells. The use of biomass implies a carbon saving per unit of electricity that is supplied to the TNEB grid which is predominantly more carbon intensive. The project also co-fires coal as fuel in the power plant.

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[29] Source Project Design Document AL Wind - Available at UNFCCC website http://unfccc.int Project Reference No 0471

[30] Source Project Design Document IndoWind – Available at UNFCCC website http://unfccc.int Project Reference Number 0277

The baseline for this activity is the equivalent amount of electricity being consumed from the regional grid. The project displaces an equivalent demand of electricity from the grid that would have otherwise been consumed from the carbon intensive grid. The project quantifies the net emission reductions based on the total electricity generated and exported to the grid after reducing the emissions from the project activity. Emissions from the project activity include emissions from use of coal as fuel and other emissions including leakage and transport of biomass.

The project quantifies emissions from coal use with the help a carbon emission factor for coal used from IPCC guidelines with the quantity of coal to be used. The project however places the leakage emissions and emissions from transport of biomass through trucks as negligible. The Validation report by the Designated Operational Entity assumes that the emissions from trucks are negligible to affect the project. The project uses an estimated total of 58,300 tonnes of Biomass per year as fuel. This requirement is judged adequate to the availability of surplus biomass in the district by an assessment done through a private agency. The project participants however revealed that the cost of Biomass has risen substantially over the past year from Rs 1000 – 1200 per tonne to Rs 1800 - 1900 per tonne.

EID Parry Co-generation from Sugar - 18MW

The CDM project activity is an efficiency upgrade project of an existing 4.5 MW low pressure Biomass power plant that uses Bagasse from the sugar mill to produce heat and electricity for processing sugar. The CDM has facilitated the installation of a high pressure power plant of 18 MW capacity that allows the generation of three times extra electricity with the same amount of Bagasse used before. The extra units after captive consumption in the Sugar factory are sold to the TNEB grid and these being generated from a renewable source, results in emission reductions. The methodology used for Additionality identifies alternatives and barriers to the project activity. The project identifies leakage from trucks that transport biomass to be used as fuel in the plant. The net emission reductions are estimated at 866,230 tonnes of Carbon dioxide equally over the ten year crediting period. Project participants revealed that the CDM revenue and revenue from sale of electricity has a positive implication on the financial performance of the sugar factory, allowing the cost of sugar production to be reduced.

Justification of choice of Projects

The choice of Projects were based on the time availability of the research and based on the three forms of renewable energy that are most common in TamilNadu. A project of each type Wind, Biomass and Co-generation was selected. Two wind projects were chosen because wind projects varied in scale from small to large. The small scale wind project is based in Tirunelveli district which is agricultural and has one of the highest wind velocities in TamilNadu. The large scale project is spread over two districts in Tirunelveli and Coimbatore which are primary wind sites of the state and some of the areas are agricultural lands. The choice of assessing a large and small scale project was to see if there were significant variations in the impacts across scales for wind energy. The Biomass project in Pudukotai was chosen for its location, Pudukottai being agricultural and the existence of other biomass plants was seen as an example of proven technology and application in the area. The Co-generation plant was chosen based on positive response from the project participants and the fact that being located in Pudukottai district was representative of the large agricultural base of the district.

4.2 Project Evaluatory Framework

The Evaluatory Framework used is modified into the table below. The Multi Criteria Analysis with the Local Level Indicators and Global Level Indicator are presented with the weights used for each. As explained in Chapter 3, the Local Level Indicators are divided into Social, Economic and Environmental criteria.

Table 3 – Evaluatory Framework Used

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Level Indicators				
	Social Criteria	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	-2>0>2		
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	-2>0>2		
	Sub – Total				
	Economic Criteria	.35			
3	Jobs Created (Types and Numbers)	.2	-2>0>2		
4	Opportunity cost of Output forgone	.15	-2>0>2		
	Sub – Total				
	Environmental Criteria	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	-2>0>2		
6	Increased Energy Capacity from renewable sources	.15	-2>0>2		
	Sub – Total				
	Total Local Sustainability score				
	Global Level Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	-2>0>2		
	Total Global Sustainability Score				

Justification of Weights

The sole Global Indicator is given a weight of 1 and the Local Indicators are given a combined weight of 1, allowing comparison between the Global and Local Level.

The local Indicators are given varied weights divided as 40 % for Social, 35% for Economic and 25% for Environmental criteria. Social criteria are given the highest weight with respect to the people centric approach of Sustainable Development. Economic criteria are given 35% of the total as they are important for development. Lastly Environmental impacts are given a lesser weight of 25%. This is due to the fact that being Renewable Energy Projects, these projects have minimal impacts on the local environment. Wind is pollution free, Air pollution resulting from combustion of Biomass is far less in comparison with fossil fuel power plants and all projects operate within State specified environmental norms.

The Indicators within each criterion are given weights according to their importance. The justification is as follows.

Social Criteria

The indicators under the Social Criterion are given a total weight of .40 in the Evaluation. Poverty Alleviation is a critical indicator. The project must under no circumstance have a negative score for this indicator. Poverty alleviation from the project activity is given a weight of .20. The Impact on Equity is also given a weight of .20 as well. Both indicators are given equal weights but a condition is that a negative score for Indicator 1 means a serious social negative impact, while a negative impact on Indicator 2 could be interesting for further investigation.

Economic Criteria

The Economic Criteria in the Evaluation is given a combined weight of .35. Indicator 3 for Jobs created are given a higher weightage of .20 as it shows the new jobs created through the project activity. The Indicator 4 - Output forgone is given a reduced weight of .15 as it shows a certain level of economic output that is no longer produced. It is important to keep in mind that all CDM projects would have a net gain in terms of output when the value of the CERs are factored in, nevertheless any loss in original output is of relevance depending on the type of output.

Environmental Criteria

The Environmental Criteria are given a total weightage of .25. The Indicator 5, Impact on local environment is given a weight of .10 in this regard. Indicator 6 represents the increase in energy capacity from renewable sources and is given a higher weight of .15. This indicator has an economic implication in terms of energy production, but given that the energy is non-polluting it is kept as an environmental indicator.

Scoring Table Used

The qualitative scoring table used for the project evaluations was developed by the SouthSouthNorth[31] matrix tool and is shown below.

Table 4 – Scoring Table Used

Score	Explanation
-2	Major Negative contribution - Significant Negative Impact with visible outcomes
-1	Minor Negative contribution – Discernable Negative impacts
0	No impact
+1	Minor Positive Impact – Discernable Positive impacts
+2	Major Positive Impact – Visible and Significant positive benefits

Subsequent to the scoring conducted under the Indicators specified earlier on the selected Projects, An overall ranking was done for all the projects using the following Equation[32]. This was used to arrive at a final score of the Local Sustainable Development impact study.

$$U(P) = \sum_{i=1}^{n} w_i u_i [c_i (P)]$$

where

c_i = Sustainability Criterion i

u_i = Single Utility of Criterion i

w_i = Weighting of Criterion

U = Overall Utility of Project

P = CDM Project

n = 3 (Social, Economic & Environmental)

[31] The SouthSouthNorth (SSN) Matrix tool for appraising the Sustainable Development Contributions from CDM Projects was presented at COP5 for HELIO International by SSN technical coordinators Steve Thorne and Emilo La Rovere. The Matrix tool has also been adapted for use by the CDM Gold Standard which conducts quality labelling of CDM projects on the basis of their contributions towards Sustainable Development.

[32] Equation adapted from the Multi-Attributive Assessment of CDM (Sutter 2003).

Explanation of the further investigation of Indicator 2 and 4 for Wind Projects

Following the Project Evaluations Indicators 2 and 4 gave reasons for further investigation in the case of Wind Energy.

Indicator No 2 revealed that as TNEB regulations required companies to have ownership of the Land before implementing the Wind Farms, the ownership of land holdings became more concentrated than previously. This has led to a certain amount of displacement[33], the investigation was undertaken as an attempt to arrive at an estimate of the number of people displaced from the Wind farm. The total area occupied by both projects in Tirunelveli district was estimated. The rural population density of Tirunelveli district from the TamilNadu Census was used to arrive at the population within the area of the project. With the use of the average family size in Tirunelveli got from the Census data, an estimate of the number of families that were affected was arrived at.

The above analysis uses a number of simplified assumptions. The most important one being that all families within the area sold and vacated their land. It is possible that only a part of the land holdings were sold allowing the people to continue living in the same area but with smaller land holdings. The TNEB guidelines of 20 to 25 acres of land per MW is relevant only for wind turbines of 225 kW capacity. Higher capacity turbines occupy less space. However the projects visited employs the use of 225 kW machines and as interactions with local communities showed, displacement of people directly attributable to wind farms has occurred in the region.

Indicator No 4 showed that some land used by wind farms which were previously under agricultural uses is no longer used for agricultural uses. From the project site maps and in-depth interviews with the project staff an estimate of the agricultural land that is no longer productive is arrived at. The primary crop being grown in Tirunelveli district being rice, the Rice productivity per acre of the district is used as a benchmark. Using the two figures an estimation of the agricultural output lost is arrived at.

The analysis is however based upon the simplified assumption that the area taken up by wind farms is used only for rice production. In reality small farmers are able to undertake farming of various crops. The other assumption used for the analysis is that only 50% of the total area used by the Wind farm is suitable for agricultural uses, this is a conservative assumption given the field data.

The analysis conducted above for the two indicators are in reality intertwined. The displaced people were primarily employed in agricultural

[33] The evidence from the field does not however indicate that the nature of the displacement was of a negative manner. No recorded cases of forced eviction was found in TamilNadu, further research would be required to assess the nature of the displacement.

activities. As a result of their displacement agricultural production on their land was stopped.

CDM Criteria Tested

The Renewable Energy CDM projects in TamilNadu were investigated on a particular aspect of the CDM. The Wind Projects were tested on the Additionality requirements and Biomass projects on the possible existence of Leakage.

Additionality - Common Practise Analysis

The basis of assessing the Additionality of each project was explained in Chapter 3. This section is devoted to further explanation of the Step 4 of the Additionality Test, the Common Practise Analysis (CPA). The CPA is used as a *credibility check* on the previous Investment Analysis and Barrier Analysis conducted.

The Common Practise Analysis consists of two sub-steps.

Sub-Step-1 Identify *Similar Activities*[34]. If similar activities are common in the relevant sector then it challenges the claim that the Project Activity is Financially Unattractive or that the Project faces barriers in existence.

Sub-Step-2 If similar activities are observed, explain essential distinctions between the proposed CDM project and the observed activities.

The first step is to *identify other activities that are similar to the proposed project activity*. This is to get an understanding of whether and to what extent similar activities have already diffused in the relevant area. If similar activities are observed, then the project developer moves to the second step. Essential distinctions between the observed activities and the proposed project activity must be explained. These distinctions may be explained by new changes in Policy, Regulatory Frameworks or any change in circumstances that rendered the observed activities viable but the CDM project unviable without the expected revenue from sale of CERs.

Leakage

The existence of Leakage was examined for the Biomass project visited. The interviews and field visits confirmed that many of the above requirements discussed in Ch 3 for establishing that leakage does not occur are far from local

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[34] *Similar Activities can be defined as activities (technology or practises) that are of similar scale, take place in a comparable environment with respect to the regulatory framework and are undertaken in the same geographical area.* (UNFCCC 2007:10) Relevant extracts on the CPA is provided in Annexure 9.

realities in TamilNadu. It was seen that on the basis of Government Studies for assessment of Biomass a clear picture of total Biomass available in the district did not emerge. The problem was that all types of Biomass identified by the studies are not usable for power generation in Biomass power plants and being almost 10 years old the relevance of the Biomass Assessment Study with the present day is limited.

The Problem of assessing surplus Biomass availability in Pudukottai district was undertaken from the Demand and Supply Side. From the demand side, interviews with Project Developers were arranged, the types, costs and seasonal variations in availability of Biomass was investigated. From the supply side, interviews with Biomass suppliers in the district who sell their residue to the projects and with the Joint Director for Agriculture in Pudukottai District was undertaken.

Excel Database

A database of all the Renewable Energy projects that have come up in TamilNadu under the CDM was created to draw inferences on the industry as a whole. Lessons were learnt on the growth of each form of renewable energy and the contribution of the CDM to the Renewables in the state. The database constructed using Excel is provided in Annexure 10.

People Interviewed

In-depth Interviews based on discussion guide was conducted with Senior Officials of the Government Agencies and Project Developers under the CDM. Other Project Developers and key persons were contacted through scheduled telephonic interviews and email questionnaires. The local residents of the areas visited included mainly agricultural farmers and small entrepreneurs. The research also benefited from a seminar on the Clean Development Mechanism in Chennai, TamilNadu where Consultants, Financial Institutions and Representatives of Designated Operational Entities were present.

Review of Literature and Secondary Data Sources

The relevant literature on Sustainable Development, Sustainability and the Clean Development Mechanism was explored. The basics of project evaluation methodologies were also used for the field visits and designing the Evaluatory framework used. The secondary data used for the study includes Government regulations, Policy Documents, Journal Articles and Grey Literature in addition to the Project Design Documents and Validation Reports of each CDM project available at the UNFCCC website and other online resources.

Chapter 5 Analysis and Findings

This chapter presents the analysis conducted and the findings. The chapter is organised by Energy Source starting with Wind, Biomass and Co-generation. The results of the project evaluations are presented for each and the results of the CDM criteria tested are explained for each type. The findings and analysis are presented in a synthesised format and the detailed project evaluation conducted for each project is given in Annexure 11. Additional findings from the interviews, database and secondary data are explained in the last section of this chapter.

5.1 Wind Energy

The evaluation of the two CDM projects selected for field visits are presented below.

AL WIND – LARGE SCALE 56.25 MW CDM Project

The large scale wind project has a no impact score on the social criteria, the project does not result in Poverty alleviation of the surrounding communities. The project has resulted in the displacement of families but the Impact on Equity is given a score of 0 as further research would be required to judge if the displacement was of a negative nature. On the Economic criteria, the project scores high on Jobs created, since it creates new jobs for both skilled and unskilled labourers. The project scores negative on the Indicator for Output forgone as a result of the agricultural activity that is no longer being produced. The opportunity cost of this Indicator when compared to the value of the CERs now generated is however less. And on the Environmental Front, the project scores positive as it is non-polluting and has increased the installed capacity of renewable energy. Being large scale, the project also scores high on the Global Indicator with a high amount CERs generated.

Table 5
Evaluation Results – Large Scale Wind Project

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social Criteria	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic Criteria	.35			
3	Jobs Created (Types and Numbers)	.2	2	.4	
4	Output forgone	.15	-1	-.15	
	Sub – Total				.25
	Environmental Criteria	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	1	.1	
6	Increased Energy Capacity from renewable sources	.15	2	.3	
	Sub – Total				.4
	Total Local Sustainability score				**.65**
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	2	2	2
	Total Global Sustainability Score				**2**

Comparison at both levels gives us a score of 2 at the Global Level and 0.65 at the local level.

INDOWIND SMALL SCALE 12.3 MW CDM Project

The small scale wind project similarly has no impact on poverty alleviation. The impacts on equity are given a score of 0 since the nature of displacement is unknown although a certain amount of displacement has occurred. The Project scores positive on the Economic criteria with the Jobs created and as the local community members are employed within the project. There is some agricultural output lost from the project but the company is in the process of organising agricultural activities in the project areas. The loss of some agricultural output results in a negative score for Indicator 4. The project scores positive on both environmental indicators due to the fact that it is non polluting and has increased the installed capacity of energyy. In terms of the Global Indicator, the project scores positive on the Global Indicator, but is small scale and so the CERs generated are less in comparison with the large scale project.

Table 6
Evaluation Results – Small Scale Wind Project

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social Criteria	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic Criteria	.35			
3	Jobs Created (Types and Numbers)	.2	1	.2	
4	Output forgone	.15	-1	-.15	
	Sub – Total				.05
	Environmental Criteria	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	+1	.1	
6	Increased Energy Capacity from renewable sources	.15	+1	.15	
	Sub – Total				.25
	Total Local Sustainability score				.3
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	1	1	1
	Total Global Sustainability Score				**1**

Comparison between the Global and Local gives us a score of 1 at the Global level and 0.3 at the local level.

The data for the Large Scale and Small Scale Wind farms show a degree of proportional impacts. The Larger project scores 2 : 0.65 and the Small project scores 1 : 0.3 in terms of ratio of Global to Local benefits. This suggests that impacts from Wind projects are largely similar and proportionate to the size of the project activity.

Impacts on Equity and Output Forgone

The further investigation of the Indicators 2 and 4 for Wind energy projects seemed relevant to the study.

Indicator number 2 revealed land ownership changes in the project area. Attempting to asses the number of people affected by the two projects, the analysis was conducted under the following simplified assumptions.

Total installed capacity for both Wind Projects in Tirunelveli District = 39.075 MW[35]

Total area used for both Wind Projects in Tirunelveli District = 39.075 * 22.5 = 879.19 Acres[36]

879.19 Acres = 3.55 square kilometres[37].

Population Density of rural Tirunelveli district per square kilometre = 239.92[38]

Average Family Size in Tirunelveli District =4[39]

Estimated total people affected from the CDM projects in Tirunelveli district are 851. This translates into approximately 212 families under the assumptions mentioned earlier. Thus we see that in a wind farm of approximately 39 MW capacity set up in rural Tirunelveli District, an impact is felt on over 200 families. In an industry that has now expanded to over 3900 MW of installed capacity in TamilNadu the numbers could be substantially more.

Indicator no 4 showed a negative value on account of the agricultural activities forsaken. The value of the lost agricultural output from the project activity is once again quantified for Tirunelveli district. This indicator finds particular relevance given the fact that Tirunelveli is an agricultural district mainly involved in rice production. The district also has one of the highest rice productivity in the state compared to the other districts at 4527 kg/Hectares in 2001[40]. This is also far higher in comparison with the average rice productivity of all districts in India estimated at 1940 kg/Hectare[41].

The two projects are located in the southern regions of Tirunelveli and as the field visits and project management revealed both projects are mostly situated on land that is suitable for agricultural uses and was mainly under rice production. A conservative assumption made here is that of the 39 MW installed in Tirunelveli District which occupies a total area of 879 Acres, only fifty percent of the full area is assumed to be previously under rice production. This leads us to almost 440 acres under rice production that no longer produce rice. Translated into hectares[42], it gives 177 hectares of land with a loss in

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35 This figure includes both the projects visited. Only the Wind Turbines in Tirunelveli District is used for the analysis.

36 This based on the guidelines by the TamilNadu Electricity Board of 20 to 25 Acres per MW. An average of 22.5 Acres / MW is used.

37 For Conversion 10,000 Acres is equal to 40.5 square kilometres.

38 Source -TamilNadu Census 2001 data. http://www.census.tn.nic.in/

39 Source -TamilNadu Census 2001 data. http://www.census.tn.nic.in/

40 Source – Directorate of Rice Development. http://www.drdpat.bih.nic.in/HS-B-Table-13-Tamil%20Nadu.htm

41 Source – Directorate of Rice Development http://drdpat.bih.nic.in/

42 A conversion scale of 1 Hectare = 2.47 Acres is used.

production. To quantify the total output lost, the product of the rice productivity per hectare is multiplied by the total hectares covered by the project activity. This leads us to a figure of 801279 kilograms of rice that are no longer produced. In all under a simplification that only 50% of the project area is suitable for agricultural activities, and that this area is suitable and was previously under rice production leads us to a loss of over 800 tonnes of rice per annum. This can be compared to the value of the newly created output from the CDM. The number of CERs from the Project activity annually is 62,737[43]. This under assumptions translates to a market value of Rs. 18,821,100[44]. The value of the output of rice forgone annually from 801279 kg is estimated at Rs. 4,006,395[45].

The analysis shows us that the market value of the rice forgone is about 21% of the value of the new output from the Project Activity.

Examination of Additionality

This section examines the findings from the analysis of the Common Practise Analysis (CPA) of all Wind Energy Projects in TamilNadu. Most CDM projects in Tamilnadu have undertaken a CPA at a National Level on the extent of penetration of Wind Energy in India as a whole. The CPA was conducted at the state level in this paper keeping in mind that all the projects examined are located in TamilNadu and all function under the same regulatory framework of the State government. Similar activities are found in the same geographical area and no distinctions in technology, scale or regulatory framework can be seen between wind farms that have availed CDM benefits or those that have not availed CDM benefits. The fact that the growth was concentrated in one geographical region furthers adds to the reasoning that the relevant comparison must be at the state level.

The Wind Industry in TamilNadu was growing at a steady pace before the implementation of the CDM. The mix of Policy Instruments and growth trends of the Industry results in what can be seen as a dynamic baseline. The analysis from the database shows that wind energy was steadily increasing in the State from 2002 onwards. The capacity additions to the Wind Energy Sector in TamilNadu from CDM Projects are shown below in the table.

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[43] The figure is scaled from the total number of CERs of the Project. Source Project Design Documents

[44] A CER price of 5 Euros, and conversion rate of 60 Indian Rupees to 1 Euro is assumed.

[45] A market price of Rs 5 per Kilo of Rice is assumed

Table 7
Growth of Wind Farms in TamilNadu (CDM and Non CDM)[46]

Year	Capacity Addition of CDM Projects	Capacity Addition of Non CDM Projects	Total Capacity Addition	Total Cumulative Installed Capacity
2002	56.25	77.35	133.6	856.665
2003	468	-96.775	371.225	990.265
2004	37.5	641.235	678.735	1361.49
2005	78.3	779.255	857.555	2040.225
2006		577.91	577.91	2897.78
2007	67.77	313.305	381.075	3475.69
2008 mid	15.625	31.25	46.875	3856.765
Total	723.445	2323.53	3046.975	3903.64

The CDM projects were implemented in stages. This means that following the CDM approval, the installation of the wind farms was done in phases. The entire capacity of the CDM project is added to the year of start of the project in the table above. The Total Capacity Addition and Total Cumulative Installed Capacity are actual figures that were added to the grid for the specified years from the TEDA website.

During the period 2002 to 2008 the total installed capacity of CDM projects were 723 MW while that of non CDM wind farms was over 2323 MW. This suggests that for every CDM wind project installed in TamilNadu since 2002, three non CDM wind farms were installed. This shows fact highlights the extent to which the practise of wind farms have been diffused in the same region. The policies of the government including wheeling options, tax benefits and high wind speeds made Wind Investments attractive in TamilNadu. In effect the presence of similar activities are established.

Interviews with all three government departments confirmed that Wind Farms coming up in TamilNadu are not differentiated among those being CDM or non CDM. In effect no essential distinctions in regulation, policy or viability are present among the Wind Farms. The costs of Wind Turbines and Installation of Wind Farms are standardised as the market has been one where several companies are present and a level playing field exists. In addition approved manufacturers of wind turbines are recommended by the State Government. All Grid Connection costs, power evacuation work to be done and other costs are fixed and undertaken by the three agencies. Clearly no distinctions between the activities exist. The data suggests that Wind Farms would have anyway grown in Tamilnadu even without the CDM, raising questions on the Additionality of Wind Energy Projects in Tamilnadu.

[46] Source – TamilNadu Electricity Board and Project Design Documents

5.2 Biomass Energy

CHITRA BIO ENERGY 7.5 MW CDM Project

The Biomass project investigated revealed the highest score towards local sustainable development among all the projects investigated. The project had a positive score towards poverty alleviation as families involved in agriculture have benefited from the extra demand for agricultural residues, there is also a positive impact on equity as more income flows to the agricultural workers. The project also creates a total of about 120 jobs including skilled and unskilled workers and scores high on the Indicator for Jobs created. The evidence is not sufficient to assess if output is forgone as a result of the project and so it is given a no impact score. The project has a minor negative impact on the local environment due to air pollution from the power plant and a positive impact on account of the increased energy production from renewable sources.

Table 8
Evaluation Results – Biomass Project

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social Criteria	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	+2	.4	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	+1	.2	
	Sub – Total				.6
	Economic Criteria	.35			
3	Jobs Created (Types and Numbers)	.2	+2	.4	
4	Output forgone	.15	0	0	
	Sub – Total				.4
	Environmental Criteria	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	-1	-.1	
6	Increased Energy Capacity from renewable sources	.15	+1	.15	
	Sub – Total				.05
	Total Local Sustainability score				**1.05**
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	1	1	1
	Total Global Sustainability Score				**1**

The project scores 1 at the Global Level and 1.05 at the local level from the analysis.

Estimation of Leakage

A brief investigation into the Biomass available in the region was conducted through the field visits and interviews. The interviews revealed that over the last year the cost of biomass fuel has gone up by over 50% and one Biomass power plant in Pudukottai District was shut down temporarily due to the non-availability of fuel in the area. The prices are an indicator of Scarcity. From an economic point of view, Surplus Biomass by definition can only command a minimum price or no price at all. The rise in prices shows that the biomass in the region has competing demands which has led to increased scarcity. The scarcity results in competition between users of the Biomass and the evidence suggests that Biomass suppliers face no difficulty in selling their entire output.

The project also uses trucks to transport the biomass to the power plant. The field visit revealed that trucks move within a 50 kilometre radius of the project location for Biomass collection. This is however accounted for as negligible in the Validation Report.

From the above analysis it is clear that competing uses for the Biomass residues exist and due to the demand from the power plants it is not clear if these uses are satisfied with the use of fossil fuels or not, leading to Leakage emissions.

5.3 Co-generation from Sugar

EID PARRY Co-generation from Sugar 18 MW CDM Project

The Co-generation project is a marginal addition to the existing Sugar Factory and has no impacts upon poverty alleviation and equity. The project scores 0 towards social criteria because relevant social impacts were part of the baseline scenario before the project. The project has a positive score on the Jobs created as a result of the workforce required to manage the power plant. There is no output that is forgone and so a no impact score is given to the Indicator. The project scores a minor negative on the impacts to the local environment as a result of the air pollution from the project, but scores positive on the Installed capacity of energy from renewable sources.

Table 9
Evaluation Results – Co-generation Project

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social Criteria	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic Criteria	.35			
3	Jobs Created (Types and Numbers)	.2	1	.2	
4	Output forgone	.15	0	0	
	Sub – Total				.2
	Environmental Criteria	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	-1	-.1	
6	Increased Energy Capacity from renewable sources	.15	2	.3	
	Sub – Total				.2
	Total Local Sustainability score				**.4**
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	2	2	2
	Total Global Sustainability Score				**2**

The project scores 2 on the Global level and 0.4 at the Local Level.

Impact of the CDM project on Sugar Production

The CDM project has resulted in overall cost savings of the Sugar Factory, The revenue from sale of electricity to the Grid and the revenue from the Sale of CERs has allowed the company to disperse its costs of sugar production. This follows from the findings of previous studies by (Markandya et al 2002:281) that Sugar Co-generation plants actually have a negative cost of emission reductions. The author estimates that the cost per tonne of carbon reduced is -244 US Dollars. The analysis places the project activity into what is commonly referred to as within a no-regrets scenario.

The CDM regulations also specify that in cases where the Power generated is used for captive purposes, a net increase in the production capacity of the plant must not result. This is argued for from the fact that if the CDM allowed the Sugar Factory to increase its production, then the total emissions from the Sugar Factory in comparison with the baseline would increase. Thus although the Factory in Pudukottai operates at full capacity already, the CDM benefits result in cost savings to the firm, granting a competitive advantage over other Sugar mills in the country. In the long run this advantage could translate into increased production.

Chapter 6 Conclusion

The CDM has developed into a source of high interest within the Renewable Energy Industry in a short span of time. The Renewable Energy Industry in Tamil Nadu (especially wind) was already growing steadily due to the incentives available and the CDM has pushed the development of the Renewable Energy Sector.

The evidence seems to suggest that some Wind Energy CDM projects in Tamilnadu may have come about with a cost to local sustainable development, in terms of the agricultural output that was forgone when the CDM Project came about. This however may be the exception instead of the norm. The field visit revealed that some Wind companies were already undertaking agriculture and others were slowly developing suitable areas for agriculture. The stoppage of agriculture seems to reflect the state policy where ownership of the land must be with the wind company before implementation of the project. Policy support to avoid the loss of output stemming from ownership change of the land may resolve the issue of a local cost.

The local sustainable development impacts of Renewable Energy CDM projects are varied. In terms of benefits, all projects create jobs and add to the Energy generation capacity of the state. The social benefits are enhanced in the Biomass project as it coordinates several of the surrounding villages for fuel supply thus having a positive impact on agricultural families in these villages. Environmentally speaking Wind remains the cleanest form, but Biomass and Co-generation plants emit air pollutants within state specified norms.

The Additionality analysis revealed that wind energy was a reasonably common practise in Tamilnadu with three times as many non CDM Wind projects coming up from the period 2002 to 2008. To compare with previous findings, an interesting finding from China was that after the emergence of the CDM, essentially all additions to the Wind, Hydro and Natural Gas sector has been with the CDM. Taken collectively this means that without the CDM incentive these industries in China would not have been growing at all. Given the policies of the Chinese government to stimulate renewables, this seems implausible (Wara and Victor 2008:13). The findings from China implies that the CDM has made what was earlier perhaps a common practise now an uncommon practise. The common practise analysis in Tamilnadu however shows that Wind energy was a reasonably diffused common practise in the state, but what is also seen from Table 7 is that the addition of non CDM Wind projects in Tamilnadu is steadily decreasing from 2005 onwards. This may be that as knowledge of the CDM improves, more investors pushed for the CDM benefits. The trend seems to suggest that eventually Wind Energy in Tamilnadu may reach the same level of uncommonness in China.

The existence of Leakage was investigated and the rise in prices showed an increase in scarcity. Biomass used as fuel in power plants could in fact be non surplus. Increased scarcity implies Leakage through possible fulfilment of alternate uses with fossil fuels. In addition vehicular emissions from transport of Biomass are assumed as negligible, adding to this, is the fact that CDM modalities call for stipulations such as the area identified for collection of Biomass for every project must not be changed during the project activity. This conflicts with local realities as Biomass producers are constantly shifting their production patterns with changes in technology and opportunities.

For the Sugar Industry the *CDM* itself is now becoming Business as Usual. The Co-generation project in the sugar factory now results in the overall costing of the entire factory becoming reduced. The profitability of the company has gone up. This means that those Sugar factories that have availed of CDM are able to produce cheaper sugar through the added revenue from CDM and the sale of power to the grid. Project developers however argue that market competitiveness and market survival in the Sugar Industry is now linked with the CDM. All in all the CDM brings to the Sugar Industry a sweet deal.

Consultants are engaged to argue the Additionality of CDM projects on behalf of the Project Developers. To a large extent within the CDM Industry, *Additionality* merely implies the possibility of *Additional Revenue* for project developers. To the CDM eligible Renewable Energy Industries in Tamilnadu *"Additionality remains possible* [47]*"*.

Bio-Mass plants including Co-generation plants have the option under the Central Ministry Guidelines to co-fire upto 25% fossil fuels during energy generation. In practice many Bio-Mass plants use excess coal as fuel since coal is cheaper than Bio-Mass. With the CDM in place any usage of coal by these has a negative impact on the Certified Emission Rreductions and hence comes under the monitoring process of the CDM. There is a disincentive now to use coal as a co-fuel in Bio-Mass plants. The CDM thus improves the efficiency of the industry from an environmental point of view.

[47] A consultants take on Additionality at a Seminar Organised on CDM in Chennai

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Annexures

Annexure- 1 Brief Explanation of the Types of Renewable Energy Studied

Wind Energy

Wind Energy is a clean and established form of energy generation. The market and technology of Wind Energy is constantly improving. Each Wind Turbine is located on a tower 45 to 90 meters in height and the wind force that causes the blades to turn creates electricity which is fed to the Grid. Energy generated is Infirm[48] in nature, depending on the wind velocities and Wind turbines have a Plant Load Factor[49] (PLF) ranging from 20% to 30% usually. There is no cost of fuel as compared to Biomass but extensive land is required for installing Wind Farms and a certain level of visual impact results.

Bio-Mass Energy

Biomass includes wood, coconut husks, Bagasse[50] and other agricultural residues and these can be used to generate heat and electricity. Energy production form Biomass causes CO_2 emissions at a reduced level than from more polluting sources[51]. Only Surplus Biomass must be used as fuel for power production according to the CDM[52]. Biomass is a source of firm power and has a PLF of about 80%. Fossil fuels such as coal can be co-fired in the power plant as fuel to generate electricity.

Co-Generation from Bagasse, Sugar Industry

Co-generation is process of using a single fuel to produce more than one form of energy. Sugar Industries create heat as well as electricity from the power-plant and use the heat for sugar processing. Most Sugar factories usually

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[48] Infirm power is that which is generated at a variable output. The generation of electricity is not constant and depends on the rotation speed of the blades which in turn depends on the wind velocity.
[49] The Plant Load Factor (PLF) is a measure of average capacity utilization factor of the Power Plant. It is the ratio of the actual output of a power plant to its output if it had operated at full capacity over a period of time. Higher Wind Velocities improves the PLF of Wind Fams.
[50] Bagasse is the residue from sugar mills after crushing of sugar canes. This is used as fuel in Co-generation plants in Sugar Factories.
[51] "Fossil fuels release Carbon dioxide captured by photosynthesis millions of years ago—an essentially "new" greenhouse gas. Biomass, on the other hand, releases carbon dioxide that is largely balanced by the carbon dioxide captured in its own growth" (NREL 2008).
[52] Non Surplus Biomass if used as fuel can result in inaccuracy in estimation of CERs through *Leakage*.

employ a low capacity Co-generation plant to generate electricity for captive use. Advances in technology allow more energy to be produced from the same quantity of Bagasse. Excess Electricity from captive use may be sold to the local Grid or third parties. Fossil fuels such as coal can be co-fired in the power plant as fuel to generate electricity and the revenue from sale of electricity can have an implication on the sugar company's returns.

Annexure -2 Relevant Policy Extracts Used for the Research

Electricity Act 2003

Section 86. (1): The State Commission shall discharge the following functions…. (e): promote cogeneration and generation of electricity from renewable sources of energy by pr suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;

National Electricity Policy 2005

Section 5.2.20 Feasible potential of non-conventional energy resources, mainly small hydro, wind and bio-mass would also need to be exploited fully to create additional power generation capacity. With a view to increase the overall share of non-conventional energy sources in the electricity mix, efforts will be made to encourage private sector participation through suitable promotional measures.

Section 5.12.1 Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.

Section 5.12.2 The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.

Section 5.12.3 Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.

Tariff Policy 2006

Section 6.4 (1) Pursuant to provisions of section 86 (1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentages for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 01, 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.

Section 6.4 (2) Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.

Section 6.4 (3) The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.

Annexure 3 – Central Government Incentives for Renewable Energy

Central Government Incentives for Wind Energy

- Accelerated depreciation on wind electric generator is permissible upto 80 % for income tax calculations subject to a minimum utilization for 6 months in the year in which deduction is claimed.
- Import of wind electric generator is permitted under Open General License
- Customs duty concessions on wind electric generators and certain essential spares.
- Tax holiday is allowed for 10 years in respect of profits / gains from the private wind electric generators

Central Government Incentives for Biomass and Co-generation Energy

- Fiscal incentives in terms of excise duty concession, reduced customs duty.
- 80 % accelerated depreciation for IT purposes in the first year of installation to industries.
- Capital subsidy @Rs.20.00 lakhs / MW subject to a maximum of 5 MW per project.
- Tax holiday for 10 years for profit from the project.

Annexure 4 Census Data From Pudukkottai District

PUDUKKOTTAI-RURAL

Parameter	Total	Male	Female	Percentage	Sex Ratio
Population	1211217	600511	610706	100	1017
Population (0-6)	154639	78907	75732	14.64	960
Scheduled Castes	221161	109583	111578	18.26	1018
Scheduled Tribes	432	214	218	0.04	1019
Literates	719477	419697	299780	68.1	714
Illiterates	491740	180814	310926	31.9	1720
Workers	597007	352122	244885	49.29	695
Main Workers	456059	298379	157680	37.65	528
Main Cultivators	215355	143236	72119	47.22	503
Main Agricultural labourers	126525	65290	61235	27.74	516
Main Workers in household industries	10482	5893	4589	2.3	779
Main Other Workers	103697	83960	19737	22.74	355
Marginal Workers	140948	53743	87205	11.64	58
Marginal Cultivators	29525	12148	17377	20.95	1430
Marginal Agricultural labour-ers	95984	32888	63096	68.1	1919
Marginal Workers in House-hold industries	3811	1023	2788	2.7	2725
Marginal Other Workers	11628	7684	3944	8.25	513
Non Workers	614210	248389	365821	50.71	1473
Households	257796				

Source :
http://www.census.tn.nic.in/pca2001.aspx
Search Criteria: Pudukotai District / Rural Data

Annexure 5 Census Data from Kurumbur Village

KURUMBUR-RURAL

Parameter	Total	Male	Female	Percentage	Sex Ratio
Population	3907	1897	2010	100	1060
Population (0-6)	491	258	233	14.37	903
Scheduled Castes	324	162	162	8.29	1000
Scheduled Tribes	0	0	0	0	0
Literates	2237	1307	930	65.49	712
Illiterates	1670	590	1080	34.51	1831
Workers	2065	1139	926	52.85	813
Main Workers	1394	843	551	35.68	654
Main Cultivators	588	351	237	42.18	675
Main Agricultural labourers	609	338	271	43.69	555
Main Workers in household industries	8	6	2	0.57	333
Main Other Workers	189	148	41	13.56	13667
Marginal Workers	671	296	375	17.17	78
Marginal Cultivators	73	37	36	10.88	973
Marginal Agricultural labourers	546	215	331	81.37	1540
Marginal Workers in Household industries	3	2	1	0.45	500
Marginal Other Workers	49	42	7	7.3	167
Non Workers	1842	758	1084	47.15	1430
Households	794				

Source : http://www.census.tn.nic.in/pca2001.aspx

Search Criteria : Pudukottai District - Aranthangi Taluk - Kurumbur Village

Annexure 6 The Clean Development Mechanism Organisational Setup and Project Cycle

The Clean Development Mechanism (CDM) functions through an elaborate Organisational Setup. The CDM is supervised by the Executive Board (EB) of the CDM. All projects are certified by the EB before Certified Emission Reductions are issued. The EB operates with the Designated National Authorities (DNA) of each country, the DNA serves as the link of the EB and the Host Country. The Projects must be certified as contributing to Sustainable Development in the Host Countries they are located in by the DNA. Each

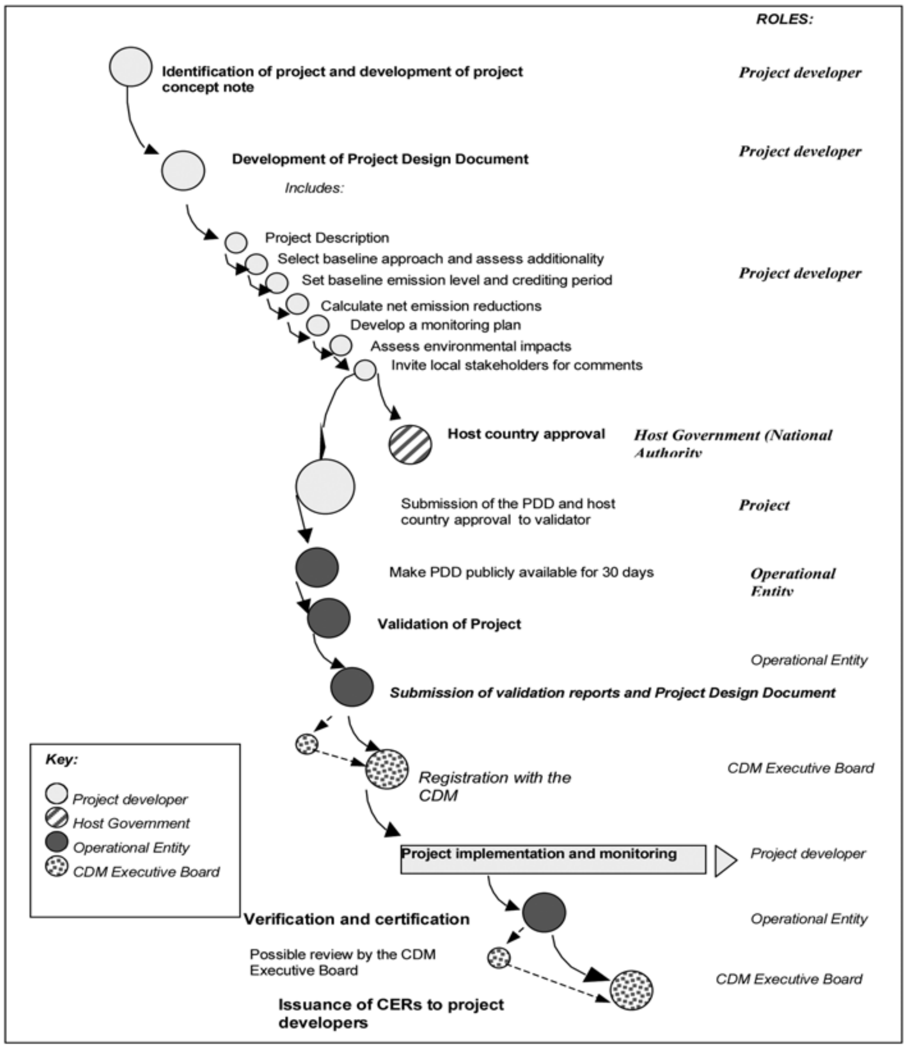
Project is independently audited for the CDM Criteria fulfilments by an external auditor, who is usually a private firm with expertise in certification and audits. These private entities are called the Designated Operational Entities (DOE). The DOE verifies that emission reductions claimed by the Project Participants are real, measurable, additional and reasonably estimated. In addition it checks the monitoring plan and actual performance of the project before recommending to the Executive Board for issuance of CERs. The Project is identified and developed by private individuals, companies and consultancies who bring technical skills as well as financing to varying degrees. Stakeholder consultation and NGO participation are present within limits in the CDM. For every CDM project considered the Designated Operational Entity has to post the Project Design Document for 30 days in the public domain inviting comments from the public at large on the application of methodology used, additionality test conducted and any other aspect of the Project that may be relevant. Each project requires a stakeholder consultation process with local communities and affected people. The Executive Board has established spaces for participation by registered NGOs through the website. The Project Developer initiates a project cycle as explained below.

The Project Developer is first involved in identification of the CDM Project and the development of the Project Design Document with adequate baseline studies, additionality tests, calculation of net emission reductions, development of a monitoring plan, assessment of environmental impacts, assessment of contributions to Sustainable Development and invitation of local stakeholder comments. Upon completion of the above tasks the Project is submitted for Host Country Approval in line with Host Country Requirements that vary for Host Countries. Upon receiving Host Country Approval, the Project Design Document is submitted along with Host Country Approval to the CDM Executive Board and a Designated Operational Entity (DOE) is allocated for the CDM project. The DOE undertakes the Validation of the Project activity and assesses the net reductions in emissions from the CDM project. It submits its Validation report along with the Project Design Documents to the CDM Executive Board upon completion of Validation. Before submission of the Reports to the CDM Executive Board the DOE may issue a Corrective Action Request to the Project Developer. Upon clarification of the Corrective Action Requests the reports are submitted to the CDM Executive Board. At this stage the Executive Board may reject, accept or Request for Reviews from the DOEs on the Project activity. In case the Project activity is accepted, it is deemed to have been registered under the CDM. Subsequent to Registration by the Executive Board the Project is implemented and Monitored by the Project Developer. Annual Verification of the Project Performance with regards to the Net Emission Reductions achieved are conducted by the DOEs and upon acceptance of the Verification reports, subjected first to possible review, the CDM Executive Board issues Certified Emission Reductions to the Project Developer.

The following figure represents the many stages through which a CDM project undergoes from Project Development to Certification and Issuance of

Certified Emission Reductions. The respective actors involved in each stage are also shown.

CDM Project Cycle [53]



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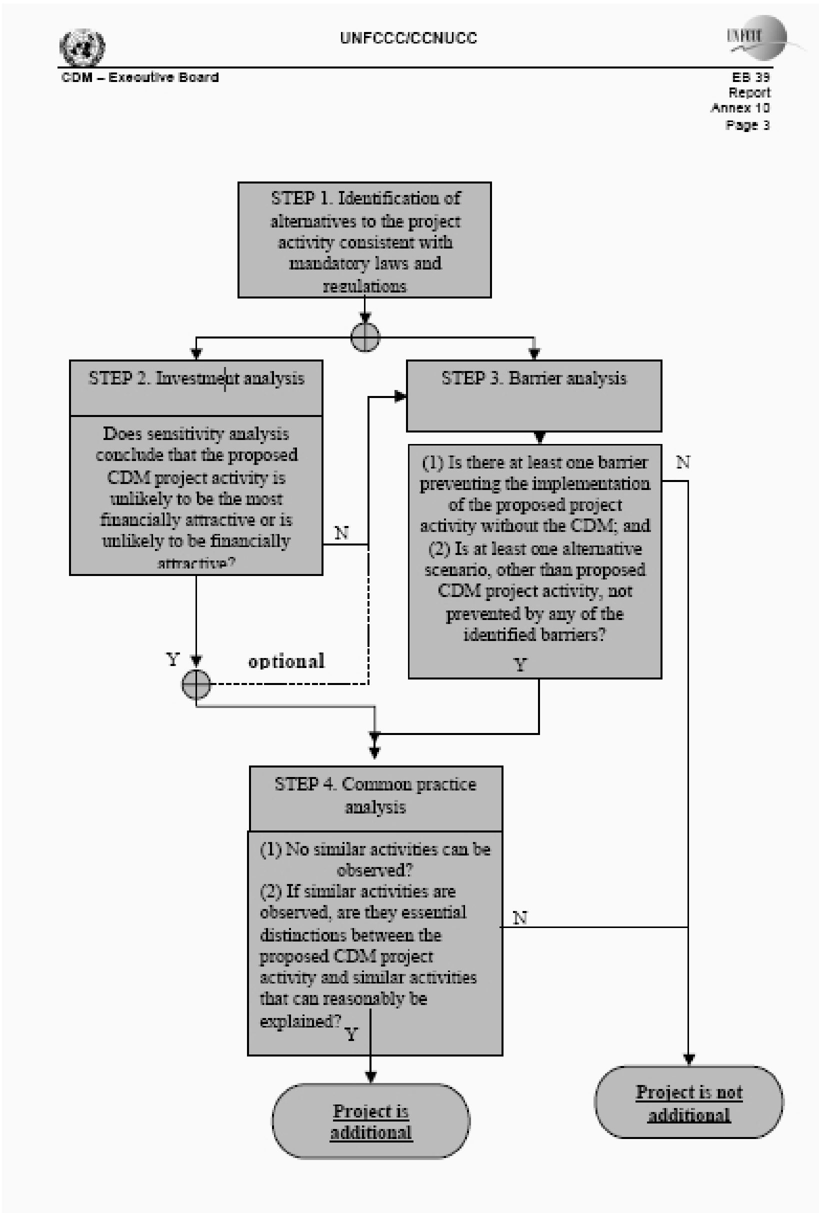
[53] Source – The Clean Development Mechanism – A Users Guide (UNDP 2003)

Annexure 7 Flow Chart for Demonstration of Additionality

Flow Chart[54]



[54] Source - CDM Executive Board. http://unfccc.int Methodological Tool for the Demonstration and assessment of Additionality.

Annexure 8 Relevant Extracts on UNFCCC Guidelines for Leakage[55]

Approaches to rule out leakage

L1

Demonstrate that at the sites where the project activity is supplied from with biomass residues, the biomass residues have not been collected or utilized (e.g. as fuel, fertilizer or feedstock) but have been dumped and left to decay, land-filled or burnt without energy generation (e.g. field burning) prior to the implementation of the project activity. Demonstrate that this practice would continue in the absence of the CDM project activity, e.g. by showing that in the monitored period no market has emerged for the biomass residues considered or by showing that it would still not be feasible to utilize the biomass residues for any purposes (e.g. due to the remote location where the biomass residue is generated).

L2

Demonstrate that there is an abundant surplus of the in the region of the project activity which is not utilized. For this purpose, demonstrate that the quantity of available biomass residues of type *k* in the region is at least 25% larger than the quantity of biomass residues of type *k* that are utilized (e.g. for energy generation or as feedstock), including the project plant.

L3

Demonstrate that suppliers of the type of biomass residue in the region of the project activity are not able to sell all of their biomass residues. For this purpose, project participants shall demonstrate that the ultimate supplier of the biomass residue (who supplies the project) and a representative sample of suppliers of the same type of biomass residue in the region had a surplus of biomass residues (e.g. at the end of the period during which biomass residues are sold), which they could not sell and which are not utilized.

L4

Identify the consumer that would use the biomass residue in the absence of the project activity (e.g. the former consumer). Demonstrate that this consumer has substituted the biomass residue diverted to the project with other types of biomass residues (and not with fossil fuels or other types of biomass than biomass residues6) by showing that the former user only fires biomass residues

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[55] Source – Table 6 Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories *I.D. Grid connected renewable electricity generation.* UNFCCC CDM – Executive Board I.D./Version 13 Sectoral Scope: 01 EB 36 (UNFCCC 2007:8)

for which leakage can be ruled out using approaches L_2 or L_3. Provide credible evidence and document the types and amounts of biomass residues used by the former user as replacement for the biomass residue fired in the project activity and apply approaches L_2 or L_3 to these types of biomass residues. Demonstrate that the substitution of the biomass residues used in the project activity with other types of biomass residues does not require a significant additional energy input except for the transportation of the biomass residues.

Where project participants wish to use approaches L_2, L_3 or L_4 to assess leakage effects, they shall clearly define the geographical boundary of the region and document it in the draft CDM-PDD. In defining the geographical boundary of the region, project participants should take the usual distances for biomass transports into account, i.e. if biomass residues are transported up to 50 km, the region may cover a radius of 50 km around the project activity. In any case, the region should cover a radius around the project activity of at least 20 km but not more than 200 km. Once defined, the region should not be changed during the crediting period(s).

Project participants shall apply a leakage penalty to the quantity of biomass residues, for which project participants cannot demonstrate with one of the approaches above that the use of the biomass residue does not result in leakage. The leakage penalty aims at adjusting emission reductions for leakage effects in a conservative manner, assuming that this quantity of biomass residues is substituted by the most carbon intensive fuel in the country.

Annexure 9 Relevant Extracts on Common Practise Analysis[56]

Step 4: Common practice analysis

Unless the proposed project type has demonstrated to be first-of-its kind (according to Sub-step a), the above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a **credibility check** to complement the investment analysis (Step 2) or barrier analysis (Step 3). Identify and discuss the existing common practice through the following Sub-steps:

Sub-step 4a: Analyze other activities similar to the proposed project activity:

(1) Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to

[56] Source - Methodological Tool for the Demonstration and Assessment of Additionality. (UNFCCC 2007:10)

financing, etc. Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis. Provide documented evidence and, where relevant, quantitative information. On the basis of that analysis, describe whether and to which extent similar activities have already diffused in the relevant region.

Sub-step 4b: Discuss any similar Options that are occurring:

(2) If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces barriers (as contended in Step 3). Therefore, if similar activities are identified above, then it is necessary to demonstrate why the existence of these activities does not contradict the claim that the proposed project activity is financially/economically unattractive or subject to barriers. This can be done by comparing the proposed project activity to the other similar activities, and pointing out and explaining essential distinctions between them that explain why the similar activities enjoyed certain benefits that rendered it financially/economically attractive (e.g., subsidies or other financial flows) and which the proposed project activity cannot use or did not face the barriers to which the proposed project activity is subject. If necessary data/information of some similar projects are not accessible for PPs to conduct this analysis, such projects can be excluded from this analysis. In case similar projects are not accessible, the PDD should include justification about non-accessibility of data/information.

(3) Essential distinctions may include a serious change in circumstances under which the proposed CDM project activity will be implemented when compared to circumstances under which similar projects were carried out. For example, new barriers may have arisen, or promotional policies may have ended, leading to a situation in which the proposed CDM project activity would not be implemented without the incentive provided by the CDM. The change must be fundamental and verifiable.

"If Sub-steps 4a and 4b are satisfied, i.e.(i) similar activities cannot be observed or (ii) similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained, then the proposed project activity is additional)".

"If Sub-steps 4a and 4b are not satisfied, i.e. similar activities can be observed and essential distinctions between the project activity and similar activities cannot reasonably be explained, the proposed CDM project activity is not additional."

Annexure 10 Project Database

Wind Project Number	UNFCCC Project Reference Number	Wind / Bio-Mass / Co-generation	Start year of Project Activity	Installed Capacity of Energy (MW)	Location of Project (District)	Estimated Annual CERs	No. of Crediting Years	Total Estmated CERs from project activity	Methodology	Large Scale / Small Scale	Calculation of Baseline	Demonstration of Additionality. Common Practise Analysis	Project Emissions and Leakage Emissions	Capacity of Wind Turbines
W1	277	Wind	2004	12.3	Tirunelveli	14416	7	100912	AMS ID	Small	Grid Emission Coefficient	National Level	Nil	225 + 250 kW
W2	471	Wind	2002	56.25	Tirunelveli + Coimbatore	47097	7	329685	ACM0002	Large	As Above	National Level	Nil	225 kW
W3	727	Wind	2004	3.6	Tirunelveli	7552	10	75527	AMS ID	Small	As Above	Nil CPA	Nil	600 kW
W4	796	Wind	2007	12	Tirunelveli	22552	10	225522	AMS ID	Small	As Above	Nil CPA	Nil	750 kW
W5	986	Wind	2007	15	Tirunelveli + 2 States	33019	10	330188	AMS ID	Small	As Above	Nil CPA	Nil	1250 kW
W6	991	Wind	2003	468	Tirunelveli + Coimbatore + Kanyakumari	686697	10	6866976	ACM0002	Large	As Above	Within CDM	NIl	225 kW to 1650 kW
W7	992	Wind	2004	14.85	Tirunelveli + Coimbatore + Erode	27963	10	279630	AMS ID	Small	As Above	Nil CPA	Nil	225 kW
W8	1015	Wind	2005	25.7	Coimbatore	40756	10	407560	ACM0002	Large	As Above	National Level	Nil	750 kW to 1650 kW
W9	1017	Wind	2007	9.92	Tirunelveli	24010	10	240103	AMS ID	Small	As Above	National Level	Nil	320 kW to 500 kW
W10	1029	Wind	2005	37.6	Nagercoil	58069	10	580690	ACM0002	Large	As Above	State Level	Nil	750 kW
W11	1047	Wind	2003	11.2	Tirunelveli	24288	7	170018	AMS ID	Small	As Above	High Technology	Nil	1250 kW to

															1650 kW
W12	1049	Wind	2005	15	Tirunelveli	37144	10	371445	AMS ID	Small	As Above	High Technol-ogy	Nil	1250 kW
W13	1053	Wind	2004	6.75	Tirunelveli	14431	10	144311	AMS ID	Small	As Above	High Technol-ogy	Nil	750 kW to 1250 kW
W14	1082	Wind	2007	7.85	Tirunelveli + 1 State	15694	10	156941	AMS ID	Small	As Above	Nil CPA	Nil	800 kW to 1250 kW
W15	1121	Wind	2007	3	Tirunelveli	5793	10	57931	AMS ID	Small	As Above	Nil CPA	Nil	500 kW
W16	1137	Wind	2007	7.25	Tirunelveli	13331	7	93317	AMS ID	Small	As Above	National Level	Nil	250 kW to 850 kW
W17	1236	Wind	2007	8.75	Tirunelveli	19269	10	192690	AMS ID	Small	As Above	High Technol-ogy	Nil	1250 kW
W18	1306	Wind	2007	4	Tirunelveli + Erode	8140	10	81400	AMS ID	Small	As Above	State Level	Nil	600 kW to 800 kW
W19	1573	Wind	2008	10	Tirunelveli	22917	7	160419	AMS ID	Small	As Above	Nil CPA	Nil	1250 kW
W20	1762	Wind	2008	5.625	Coimbatore	10671	7	74697	AMS ID	Small	As Above	Nil CPA	Nil	225 kW

Project Number	UNFCCC Project Reference Number	Wind / Bio-Mass / Co-generation	Start year of Project Activity	Installed Capacity of Energy (MW)	Location of Project (District)	Estimated Annual CERs	No. of Crediting Years	Total Estmated CERs from project activity	Methodology	Large Scale / Small Scale	Total Project Emissions / year	Calculation of Baseline	Validated Emissions from Leakage tCo2/year	Assessment of Surplus Biomass	Demonstration of Additionality. Common Practise Analysis	Total Biomass Used tons / year
B1	111	Biomass	2004	18	Ramanathapuram	66821	10	668210	AM0004	Large	15025	Grid Emission Coefficient	0	Private Study	National Level	180000
B2	127	Sugar Co-generation	2005	22	Ramanathapuram	80157	10	801573	AM0015	Large	0	Grid Emission Coefficient	0	Not Applicable	National Level	NA
B3	713	Textile Co-generation	2003	4.5	Theni	19369	10	193693	AMS IC	Small	8268	Grid Emission Coefficient	0	Private Study	State Level	25870
B4	736	Biomass	2006	7.5	Pudukottai	22571	7	158002	AMS ID	Small	21469	Grid Emission Coefficient	0	Private Study	State Level	58300
B5	1126	Biomass	2007	7.5	Dindigul + Pattukkotai	70382	10	703825	AMS ID	Small	0	Grid Emission Coefficient	0	TEDA Study 1999	State Level	NA
B6	1139	Sugar Co-generation	2007	18	Pudukottai	86623	10	866230	ACM0006	Large	264	Grid Emission Coefficient	0	Not Applicable	National Level	NA
B7	1260	Biomass	2007	9	Sivagangai	48319	7	338230	AMS ID	Small	140	Grid Emission Coefficient	0	Private Study	State Level	72000
B8	1302	Biomass	2007	1.25	Coimbatore	6248	7	43734	AMS ID	Small	56	Grid Emission Coefficient	56	Private Study	National Level	13140
B9	1548	Biomass	2008	10	Pudukottai	27567	7	192969	AMS ID	Small	26013	Grid Emission Coefficient	0	Private Study	State Level	83214

Annexure 11 Project Evaluations Conducted

Evaluatory Framework for Bio Mass Projects

Project Visited: Auromira Bio Energy

Date of Visit: 13/8/2008

Scoring Table

Score	Explanation
-2	Major Negative contribution - Significant Negative Impact with visible outcomes
-1	Minor Negative contribution – Discernable Negative impacts
0	No impact
+1	Minor Positive Impact – Discernable Positive impacts
+2	Major Positive Impact – Visible and Significant positive benefits

Local Level Indicators

1. Social Indicators

Poverty Alleviation as a result of project activity +2

Project is located in backward area of Pudukotai district in Tamil Nadu. The surrounding villages are composed of mainly agricultural families which supply Biomass to the project. Main occupation of people is based on agricultural activities. With the implementation of the stand alone Bio-Mass project an additional demand for Agricultural residue has come up. This results in less agricultural crop residue wastage and an additional source of income for farmers who now sell the Bio-Mass to the project. The rates of Bio-Mass have also been gradually increasing giving more income for farmers. Employment opportunities have also come about from the CDM project. About 70 Below Poverty Line families involved in agricultural activities have gotten additional source of income from new jobs and the sale and of Biomass. The Indicator is given a positive score of 2.

Impact on Equity – Redistribution of Capital (Income/Land) +1

The project increases income to agricultural farmers, there is no significant land ownership changes. Due to a marginal increase in incomes the Indicator is given a positive score of 1.

2. Economic Indicators

Jobs created directly as a result of project activity +2

A total of 120 to 125 jobs have been created for the project activity from a baseline of zero. 50 of these are skilled labourers who have had either technical education or project management training. High skilled workers employed by the project include Engineers, Electricians, Maintenance Workers, Finance and Accounting Persons and Human Resource Managers. In addition to this about 70 to 75 labourers depending on seasonal requirements are employed for the project activity to load and unload the fuel, feed, operate and secure the power plant. The Indicator is given a positive score of 2.

Output forgone 0

The project supposedly utilises *surplus* Biomass in the region that would have otherwise been wasted without any productive use. However as the prices of the Biomass used has increased by 50% in the last year, this indicates that alternate uses for Biomass exists. In case surplus Biomass is used, the score would have been positive. Since the data indicates that there is a scarcity of Biomass, some uses for the Biomass may as a result be unfulfilled or fulfilled through other means. As a result the indicator is given a score of 0.

3. Environmental Indicators

Impact on Local Environment (Air, Water, Soil) -1

The project emits fumes from the combustion of Biomass. The chimney height of the project is 50m and the emissions form the project activity include SOx and NOx which are within the TNPCB set limits and frequent checks are conducted on these emissions. Solid Particulate Matter emitted is also checked frequently and found within the permissible limits of the TNPCB. The project uses Biomass that is brought in from nearby villages through trucks. This results in vehicular emissions.

The project uses an Air cooled condenser and helps to avoid drawing ground water for the cooling of boiler. The project draws minimal ground water for use in the drought prone area of Pudukottai district

There is no direct impact on Soil – Ash from project activity is used as manure for farming.

Hence the project has a negative impact on the Air quality although within state stipulated norms, a minor impact on Water resources and no impact on Soil. The indicator is given an overall score of negative 1.

Increased energy production capacity +1

Energy Production capacity from renewable and less polluting sources as a result of the Project activity has increased by 7.5MW. This is from a baseline situation of zero. The Indicator is given a score of positive 1.

Global Level Indicator

Reduced GHG emissions +1

Green House Gas emissions reduced are measured in tonnes of Carbon dioxide. This figure is measured from the established baseline and gotten from the Project Design Document. The project activity has an average annual reduction of 22,571 tonnes of CO2 resulting in an estimated total reduction of 158,002 tonnes of CO2 over a seven year crediting period. The project utilises coal as a fuel and so the CERs generated are reduced. The Global Indicator is given a score of positive 1.

Final Project Scoring[57]

$$U(P) = \sum_{i=1}^{n} w_i \, u_i \, [c_i \, (P)]$$

where

c_i = Sustainability Criterion i

u_i = Single Utility of Criterion i

w_i = Weighting of Criterion

U = Overall Utility of Project

P = CDM Project

n = 3 (Social, Economic & Environmental)

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57 Equation adapted from the Multi-Attributive Assessment of CDM (Sutter 2003).

Project Scoring Table

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	+2	.4	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	+1	.2	
	Sub – Total				.6
	Economic	.35			
3	Jobs Created (Types and Numbers)	.2	+2	.4	
4	Output forgone	.15	0	0	
	Sub – Total				.4
	Environmental	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	-1	-.1	
6	Increased Energy Capacity from renewable sources	.15	+1	.15	
	Sub – Total				.05
	Total Local Sustainability score				1.05
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	1	1	1
	Total Global Sustainability Score				1

The Biomass project has a Sustainable Development score of 1 at the Global level and 1.05 at the Local level.

Evaluatory Framework for Co-generation Projects

Project Visited: EID PARRY – Co-Generation from Sugar

Date of Visit: 11/8/2008

Scoring Table

Score	Explanation
-2	Major Negative contribution - Significant Negative Impact with visible outcomes
-1	Minor Negative contribution – Discernable Negative impacts
0	No impact
+1	Minor Positive Impact – Discernable Positive impacts
+2	Major Positive Impact – Visible and Significant positive benefits

Local Level Indicators

1. Social Indicators

Poverty Alleviation as a result of project activity 0

Pudukottai District is an agricultural district with the majority of the workforce engaged in Agriculture. The project mainly uses Bagasse from the sugar factory as fuel. In addition it also uses other Bio-Fuels such as Juliflora, Coconut husks, Groundnut shells, Cane trash, Coir pith etc. The Project activity has not created a new demand for these agricultural residues since in the baseline scenario the previous power plant would have used the same fuel. There is no additional Poverty Alleviation as a result of the Project. The Indicator is given a score of 0.

Impact on Equity – Redistribution of Capital (Income/Land) 0

The project is a small addition to the baseline situation of a sugar factory. There is no significant land required for the Project. No additional income is generated for the local communities. The Indicator is given a score of 0.

2. Economic Indicators

Jobs created directly as a result of project activity +1

In addition to the existing baseline of the sugar complex, the project has resulted in a total of about 50 new jobs. The employees are comprised of approximately 15 skilled technicians for plant maintenance, operation and supervision. The workers are mechanical and electrical engineers employed from within the state. There is now more employment opportunity for persons with technical education in the rural areas. 35 unskilled labour oriented workers used for fuel collection, Transport, Handling, Loading, Unloading and Feeding. The Indicator is given a positive score of 1.

Output forgone 0

There is no output forgone as a result of the CDM project. The Bagasse employed as fuel would have been used for energy generation even without the Project. The Indicator is given a score of 0.

3. Environmental Indicators

Impact on Local Environment (Air, Water, Soil) -1

The project activity releases NOx and SOx as a result of the combustion of Biomass in the powerplant. These emissions are however well within the TamilNadu Pollution Control Board standards set. Solid Particulate Matter (SPM) is present which is left out from the chimney. The chimney height is now 95m as opposed to 40m earlier. Hence less particulate pollution occurs with negligible SO2 emissions as compared to fossil fuels. Hence although well within the TNPCB stipulated air quality standards there is some negative impact upon local air quality.

The project uses an Air cooled condenser and helps to avoid drawing ground water for the cooling of boiler. There is a high saving in water consumption but at a higher capital expense for the air cooled condenser. Total savings in water is estimated to be about 6000 tonnes. Nevertheless the project draws ground water for use in the drought prone area of Pudukottai district.

The project has no direct impact on Soil. – Ash from project activity is used as manure for farming.

The project has a minor negative impact on Air and Water and no impact on the Soil in the local area. The Indicator is given a score negative 1.

Increased Energy Production Capacity **+2**

From the baseline scenario energy production capacity has gone up by 13.5MW. From an earlier installed capacity of 4.5MW the project is now having an installed capacity of 18MW with the same fuel usage. The excess energy generated is sold to TNEB. The energy efficiency and generation has gone up by four times. The Indicator is given a positive score of 2.

Global Level Indicator

Reduced GHG emissions **+2**

Green House Gas emissions reduced are measured in tonnes of Carbon dioxide. This figure is measured from the established baseline and gotten from the Project Design Document. The project activity has an annual reduction of 86,623 tonnes of CO2 resulting in an estimated total reduction of 866,230 tonnes of CO2 over a ten year crediting period. This is high increase from the baseline and the Indicator is given a score of positive 2.

Final Project Scoring[58]

$$U(P) = \sum_{i=1}^{n} w_i \, u_i \, [c_i \, (P)]$$

where

c_i = Sustainability Criterion i

u_i = Single Utility of Criterion i

w_i = Weighting of Criterion

U = Overall Utility of Project

P = CDM Project

n = 3 (Social, Economic & Environmental)

Project Scoring Table

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic	.35			
3	Jobs Created (Types and Numbers)	.2	1	.2	
4	Output forgone	.15	0	0	
	Sub – Total				.2
	Environmental	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	-1	-.1	
6	Increased Energy Capacity from renewable sources	.15	2	.3	
	Sub – Total				.2
	Total Local Sustainability score				.4
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	2	2	2
	Total Global Sustainability Score				2

58 Equation adapted from the Multi-Attributive Assessment of CDM (Sutter 2003).

The Co-generation project has a Sustainable Development score of 2 at the Global level and 0.4 at the Local level.

Evaluatory Framework for Wind Projects

Project Visited: AL Wind

Date of Visit: 18/8/2008

Scoring Table

Score	Explanation
-2	Major Negative contribution - Significant Negative Impact with visible outcomes
-1	Minor Negative contribution – Discernable Negative impacts
0	No impact
+1	Minor Positive Impact – Discernable Positive impacts
+2	Major Positive Impact – Visible and Significant positive benefits

Local Level Indicators

1. Social Indicators

Poverty Alleviation as a result of project activity 0

The project uses extensive land for installation of wind turbines that generate electricity. The operation of the wind farm is by large automated. There is no direct impact on Poverty alleviation from the CDM Project. The indicator is given a score of 0.

Impact on Equity – Redistribution of Capital (Income/Land) 0

The project has seen the ownership of more than 1400 acres of land become concentrated into one company. This results in displacement but the nature of the displacement is not necessarily negative as the evidence shows, However this CDM project was one of the first CDM projects in TamilNadu. Interviews confirmed that land prices have gone up substantially in the last year and half. The project was set up in 2002 and the land was purchased at much lower values than the current land value. The ownership rights and rights to productive use of the entire land are now concentrated within a single company. But as further research is required on the judgement as to whether of the Impact on Equity has been negative displacement. Hence the indicator is given a score of 0.

2. Economic Indicators

Jobs created directly as a result of project activity +2

The project employs a total of around 90 persons covering the entire area of the project activity. About 50 high skilled workers are employed through the project as Mechanics and Engineers for operation and maintenance of the wind farm. About 40 people are employed as security guards. The entire jobs created are additional and due to the project. The Indicator is given a score of positive 2.

Output forgone -1

Some parts of the project has come up over agricultural land where rice and other crops were once cultivated. The company has a policy to avoid farming due to the perceived difficulties in organising the workers and labourers. As a result some agricultural output is forgone. This when compared to the value of Certified Emission Reductions are only a minor percentage, and hence there exists the tendency of the project developer to forsake this agricultural output. Nevertheless the project has resulted in some agricultural production to no-longer continue and the Indicator is given a score of negative 1.

3. Environmental Indicators

Impact on Local Environment (Air, Water, Soil) +1

The Project activity has no impact on Air, water or soil for the local environment. There is no drain on Natural Resources and the Indicator is given a score of positive 1.

Increased Energy Production Capacity +2

The project sees the installation of 56.25MW of additional energy production capacity. This is from a baseline of zero. The entire capacity addition is from one of the cleanest sources of energy. The Indicator is given a score of positive 2.

Global Level Indicator

Reduced GHG emissions +2

Green House Gas emissions reduced are measured in tonnes of Carbon dioxide. This figure is measured from the established baseline and got from the Project Design Document. The project activity has an estimated average annual reduction of 47,097 tonnes of CO2 resulting in an estimated total reduction of 329,685 tonnes of CO2 over a seven year crediting period. The Indicator is given a positive score of 2.

Final Project Scoring

$$\mathbf{U(P) = \sum_{i=1}^{n} w_i\, u_i\, [c_i\, (P)]}$$

where

c_i = Sustainability Criterion i

u_i = Single Utility of Criterion i

w_i = Weighting of Criterion

U = Overall Utility of Project

P = CDM Project

n = 4 (Social, Economic, Environmental & Technological)

Project Scoring Table

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic	.35			
3	Jobs Created (Types and Numbers)	.2	2	.4	
4	Output forgone	.15	-1	-.15	
	Sub – Total				.25
	Environmental	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	1	.1	
6	Increased Energy Capacity from renewable sources	.15	2	.3	
	Sub – Total				.4
	Total Local Sustainability score				.65
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	2	2	2
	Total Global Sustainability Score				2

The Large scale wind project has a Sustainable Development score of 2 at the Global level and .65 at the Local level.

Evaluatory Framework for Wind Projects

Project Visited: INDO Wind

Date of Visit: 21/8/2008

Scoring Table

Score	Explanation
-2	Major Negative contribution - Significant Negative Impact with visible outcomes
-1	Minor Negative contribution – Discernable Negative impacts
0	No impact
+1	Minor Positive Impact – Discernable Positive impacts
+2	Major Positive Impact – Visible and Significant positive benefits

Local Level Indicators

1. Social Indicators

Poverty Alleviation as a result of project activity 0

The project uses extensive land for installation of wind turbines that generate electricity. The operation of the wind farm is by large automated. There is no direct impact on Poverty alleviation from the CDM Project. The indicator is given a score of 0.

Impact on Equity – Redistribution of Capital (Income/Land) 0

The project has seen the ownership of more than 250 acres of land become concentrated into one company's ownership. This has caused some displacement but the nature of the displacement is not necessarily negative. Some families were willing to sell their land. However this CDM project was also one of the earlier CDM projects implemented. Land prices have gone up substantially in the last year and half. The project was set up in 2004 and the land was purchased at much lower values than the current market value of the land. The rights of land are now concentrated within a single company but uncertainty in the negative impact of the displacement gives this indicator a score of 0.

<u>2. Economic Indicators</u>

Jobs created directly as a result of project activity +1

The project employs a total of around 35 persons covering the entire project activity. About 18 are involved as security guards and about 17 skilled workers are employed through the project as Mechanics and Engineers for operation and maintenance of the wind farm. The Indicator is given a score of positive 1.

Output forgone -1

Some parts of the project has come up over agricultural land where rice and other crops were once cultivated. As a result some agricultural output is forgone. This when compared to the value of Certified Emission Reductions are only a minor percentage, and hence there exists the tendency of the project developer to forsake this agricultural output. The company is slowly trying to undertake agriculture production in the suitable areas but this has not yet been implemented. Nevertheless the project has resulted in some agricultural production that is now lost and the Indicator is given a score of negative 1.

<u>3. Environmental Indicators</u>

Impact on Local Environment (Air, Water, Soil) +1

The Project activity has no impact on Air, water or soil for the local environment. There is no drain on Natural Resources and the Indicator is given a score of positive 1.

Increased Energy Production Capacity +1

The project sees the installation of 12.3 MW of additional energy production capacity. This is from a baseline of zero. The entire capacity addition is from one of the cleanest sources of energy. The Indicator is given a score of positive 1.

Global Level Indicator

Reduced GHG emissions **+1**

Green House Gas emissions reduced are measured in tonnes of Carbon dioxide. This figure is measured from the established baseline and got from the Project Design Document. The project activity has an estimated average annual reduction of 14,416 tonnes of CO2 resulting in an estimated total reduction of 100,912 tonnes of CO2 over a seven year crediting period. The Indicator is given a score of positive 1.

Final Project Scoring[59]

$$U(P) = \sum_{i=1}^{n} w_i u_i [c_i (P)]$$

where

c_i = Sustainability Criterion i

u_i = Single Utility of Criterion i

w_i = Weighting of Criterion

U = Overall Utility of Project

P = CDM Project

n = 3 (Social, Economic & Environmental)

Project Scoring Table

No	Indicators	Weights	Score	Weighted Score	Final Score
	Local Indicators				
	Social	.40			
1	Poverty Alleviation from Project Activity – Critical Indicator	.2	0	0	
2	Impact on Equity – Redistribution of Capital (Income/Land)	.2	0	0	
	Sub – Total				0
	Economic	.35			
3	Jobs Created (Types and Numbers)	.2	1	.2	
4	Output forgone	.15	-1	-.15	
	Sub – Total				.05
	Environmental	.25			
5	Impact on Local Environment and Natural Resource Sustainability	.1	+1	.1	

[59] Equation adapted from the Multi-Attributive Assessment of CDM (Sutter 2003).

6	Increased Energy Capacity from renewable sources	.15	+1	.15	
	Sub – Total				.25
	Total Local Sustainability score				.3
	Global Indicator				
	Quantum of Certified Emission Reductions (tCO_2)	1	1	1	1
	Total Global Sustainability Score				1

The small scale wind project has a Sustainable Development score of 1 at the Global level and .3 at the Local level.

Annexure 12 List of Interviewees

No	Name	Organisation
1	Dr. A E Rajkumar	Industrial and Technical Consultancy Organisation of TamilNadu
2	D Vaidyanathan	Industrial and Technical Consultancy Organisation of TamilNadu
3	Santonu Kashyap	Asia Carbon Emission Management
4	Santosh Kamat	Auromira Energy Limited
5	C R Madhu	Auromira Energy Limited
6	Raja Sukumar	Indowind Energy Limited
7	K N Radhakrishnan	EID Parry Limited
8	W R Vasudevan	EID Parry Limited
9	P R Muralidharan	Tamil Nadu Energy Development Agency
10	C M Sambasivam	A L Wind Energy
11	C Baskaran	A L Wind Energy
12	T Chandramoulee	TCP Limited
13	HetalKumar Shah	Reliance Innoventures
14	R K Sethi	National CDM Authority
15	Krishnamurthi	Joint Director – Agriculture. Pudukotai District
16	N Sekar	TamilNadu Electricity Board
17	S Thulasi	TamilNadu Electricity Board