NATIONAL CARBON FINANCE STRATEGY OF SRI LANKA

First Draft for discussion

Prepared By
DR. B.M.S. Batagoda

Consultant, the CF Assist Program
The World Bank

For

Ministry of Environment
82, Rajamalwatta Road
Battaramulla
Sri Lanka

And

The CF Assist Program
Carbon Finance Unit
The World Bank

4 September 2006

TABLE OF CONTENTS

CHAPTER 4 - NATIONAL SECTOR BASELINES FOR CDM PROTECT ACTIVITIES 78

CHAPTER 5 - OVER ALL SRI LANKAN CDM OPPORTUNITIES AND POTENTIAL 96

List of figures

List of tables

EXECUTIVE SUMMARY

- To be done -

CHAPTER 1 - INTRODUCTION TO CLIMATE CHANGE UNFCC, KYOTO PROTOCOL AND CDM RULES IN RELATION TO SRI LANKA

1.1. Introduction

The Earth is getting warmer and over the past 100 years, the average temperature on the Earth has increased by more than half a degree Celsius. The 1980s and 1990s were the warmest decades on records, and the 20th century the warmest in the past 1000 years. According to the Intergovernmental Panel on Climate Change (IPCC), average global temperatures are expected to rise by 1.4 to 5.8 Celsius over the next century. To understand what this means that today's average global temperatures are only about 5^0 Celsius warmer than they were during the last Ice Age. Global mean sea levels are set to rise by 9 - 88 cm by 2100, flooding many low-lying coastal areas. Changes in rainfall patterns are also predicted, increasing the threat of drought or floods in many regions. Overall, the climate is likely to become more variable, with a greater threat of extreme weather events, such as intense storms and heat waves. The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), released in 2001, confirms that "an increasing body of observations gives a collective picture of a warming world" with "new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities". The IPCC updated the findings of its 1995 Second Assessment Report and projects that the climate will change more rapidly than previously expected. While the world's climate has always varied naturally, the vast majority of scientists now believe that rising concentrations of "greenhouse gases" in the Earth's atmosphere, resulting from economic and demographic growth over the last two centuries since the industrial revolution, are overriding this natural variability and leading to irreversible climate change.

1.1.1 Greenhouse effect

Gases in our atmosphere, including water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs) and perfluorocarbons act like a greenhouse to keep the sun's heat in and help make our planet livable. Greenhouse gases (GHGs) control energy flows in the atmosphere by absorbing infra-red radiation. These trace gases comprise less than 1% of the atmosphere. Their levels are determined by a balance between "sources" and "sinks". Sources are processes that generate greenhouse

gases; sinks are processes that destroy or remove them. Humans affect greenhouse gas levels by introducing new sources or by interfering with natural sinks. Without this natural insulation, the Earth's surface would be much colder than it is now. In fact, the average temperature on Earth would be –18 Celsius, too cold to support the diversity of life we have today. Water vapour is the most common greenhouse gas. Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_20) are particularly important to climate change because they are closely associated with human activities.

Carbon dioxide is currently responsible for over 60% of the "enhanced" greenhouse effect, which is responsible for climate change. Carbon dioxide is released to the atmosphere through natural processes of plant and animal life. Photosynthesis the process which plants take in carbon dioxide, remove carbon dioxide from the atmosphere. Burning coal, oil, and natural gas is releasing the carbon stored in these "fossil fuels" at an unprecedented rate. Deforestation releases carbon stored in trees. Current annual emissions amount to over 7 billion tones of carbon, or almost 1% of the total mass of carbon dioxide in the atmosphere. Methane (CH_4) is not as abundant as carbon dioxide, but is a powerful greenhouse gas and more effective in trapping heat. It is created when vegetation is burned, digested, or rotten in an oxygen-free environment. Wetlands, rice fields, animal digestive processes, and decaying garbage are the greatest sources of methane in our atmosphere. Nitrous oxide (N_20) occurs naturally in the environment, but human activities increase the quantities. Nitrous oxide is released when chemical fertilizers and manure are used in agriculture.

Since the Industrial Revolution, developed countries produced increasing quantities of greenhouse gases, due to burning of fossil fuels such as coal, oil, and natural gas to drive our vehicles and power our industries. Our human activities, such as the clearing of land for agriculture and urban development, land filling and other waste disposal methods, are also adding to the concentration of greenhouse gases in our atmosphere. As a result, concentration of greenhouse gases particularly, carbon dioxide in the atmosphere has increased by 31 percent since 1895. Atmospheric carbon dioxide concentration during the pre-industrial period was 280 ppm (parts per million), which is now about 380 ppm. Concentration of methane and nitrous oxide has increased by 151 percent.

1.2 Global Climate in the 20th Century

Climate Change according to the IPCC refers to "a statistically significant variation in either the mean state of the *climate* or it is variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing or to persistent a*nthropogenic* changes in the composition of the *atmosphere* or in *land use"*. The *United Nations Framework Convention on Climate Change* (UNFCCC) defines climate change as " a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over a comparable time period" (Article 1, UNFCCC). Climate variability refers to variations in the mean state and other statistics (such as standard deviation, the occurrence of extremes

etc.) of the *climate* on all *temporal* and *spatial scales* beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (internal variability) or to variations in the natural or *anthropogenic external forcing* (external variations) (IPCC,2001).

1.3 Temperature Changes

Observed changes in the earth's surface temperature indicate that during the 20th century, the global mean temperature had increased by 0.60C +/- 0.2 ^{0}C (Table 1). The IPCC publications state that it is 'likely'[2] that the 1990's has been the warmest decade and that it is 'likely', that 1998 was the warmest year since 1861. Temperature increases were greater over land than over oceans.

---

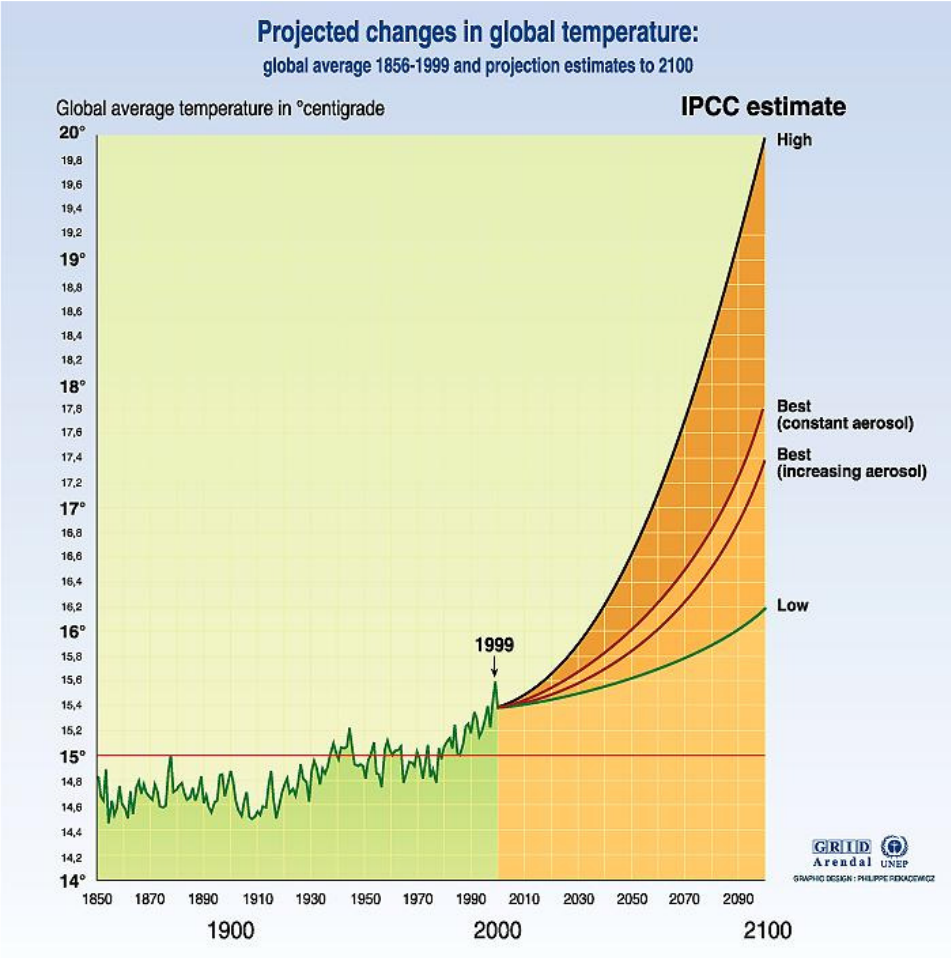
1. Unless otherwise acknowledged, the information provided here is based on IPCC
2. Likelihood refers to judgmental estimates of confidence used by TAR WG1 (IPCC,2001).

*Likely- (66-90% chance) ** Very likely- (90-99% chance)

The diurnal surface temperature range had decreased over land but the nighttime daily minimum temperatures had increased, at twice the rate of daytime maximum temperature, i.e. at the rate of about 0.2^{0}C per decade.

Concentration of greenhouse gases such as carbon dioxide (CO_2), Methane (CH_4), nitrous oxide (N_2O), and ozone (O_3) had been increasing during the 20thcentury. Strong evidence from observations indicates that global warming during second half of the 20th century can be attributed to anthropogenic activities that had increased greenhouse gas concentrations (Fig 1).During the pre-industrial era (between 1000-1750 AD), for example, the CO_2 concentrations had amounted to 280 ppm (parts per million) but had increased by 31 +/-4% to 368 ppm in 2000 (Table 1 and Table 2). The growth rates of CO_2 concentrations had accelerated after the Industrial Revolution due mainly to fossil fuel emissions although clearing of forest cover had contributed to 1/3 of the emissions in the past.

Figure 1- Predicted changes in global temperature



Source : Temperatures 1856 - 1999: Climatic Research Unit, University at East Anglia, Norwich UK. Projections: IPCC report 95.

Table 1 - 20th century changes in the Earth's atmosphere and climate *

Indicator	***Observed Changes***
1.Concentration Indicators Atmospheric concentration of CO_2	280 ppm for the period 1000-1750 to 368 ppm in year 2000(31+/_ 4% increase)
Terrestrial biospheric CO_2 exchange	Cumulative source of about 30 Gt C between the

	years 1800 and 2000; but during the 1990s, a net sink of about 14+/-7 Gt C.
Atmospheric concentration of CH_4	700 ppb for the period 1000-1750 to 1,750 ppb in year 2000 (151 +/- 25% increase)
Atmospheric concentration of N_2O	270 ppb for the period 1000-1750 to 316 ppb in year 2000 (17+/-5 % increase)
Tropospheric concentration of O_3	Increased by 35+/-15% from the years 1750 to 2000, and varies with region.
Stratospheric concentration of O_3	Decreased over the years 1970 to 2000, varies with altitude and latitude.
Atmospheric concentrations of HFCs, PFCs, and SF_6	Increased globally over the last 50 years.
2. Weather Indicators	
Global mean surface temperature	Increased by 0.6+/-0.2^{0}C over the 20th century; land areas warmed more than the oceans (*very likely*).
Northern Hemisphere surface temperature	Increase over the 20th century greater than during any other century in the last 1,000 years; 1990s warmest decade of the millennium (*likely*)
Diurnal surface temperature range	Decreased over the years 1950 to 2000 over land: night time minimum temperatures increased at twice the rate of daytime maximum temperatures (*likely*)
Hot days / heat index	Increased (*likely*)
Cold / frost days	Decreased for nearly all land areas during the 20th century (*very likely*)
Continental precipitation	Increased by 5-10% over the over the 20th century in the Northern Hemisphere (*very likely*), although decreased in some regions (e.g., north and west Africa and parts of the Mediterranean).
Heavy precipitation events	Increased at mid-and high northern latitudes (*likely*).
Frequency and severity of drought	Increased summer drying and associated incidence of drought in a few areas (*likely*). In some regions, such as parts of Asia and Africa, the frequency and intensity of droughts have been observed to increase in recent decades.

Likelihood refers to judgmental estimates of confidence used by TAR WG1
*Likely- (66-90% chance)
** Very likely- (90-99% chance)

Source: IPCC (2001)

Table 2 - 20th century changes in the biophysical system 1

Indicator	***Observed Changes***
1. Biological and Physical indicators Global mean sea level	Increased at an average annual rate of 1 to 2 mm during the 20th century
Duration of ice cover of rivers and lakes	Decreased by about 2 weeks over the 20th century in mid - and high latitudes of the Northern Hemisphere (*very likely*)
Arctic sea-ice extent and thickness	Thinned by 40% in recent decades in late summer to early autumn (*likely*) and decreased in extent by 10-15% since the 1950s in spring and summer.
Non-polar glaciers	Widespread retreat during the 20th century.
Snow cover	Decreased in area by 10% since global observations became available from satellites in the 1960s (*very likely*)
Permafrost	Thawed, warmed, and degraded in parts of the polar, sub-polar, and mountainous regions.
El Nino events	Became more frequent, persistent, and intense during the last 20 to 30 years compared to the previous 100 years.
Growing season	Lengthened by about 1 to 4 days per decade during the last 40 years in the Northern Hemisphere, especially at higher latitudes.
Plant and animal ranges	Shifted poleward and up in elevation for plants, insects, birds and fish. Earlier plant flowering, earlier bird arrival, earlier dates of breeding season, and earlier emergence of insects in the Northern Hemisphere.
Breeding, flowering and migration Coral reef bleaching	Increased frequency, especially during El Nino events.

2. Economic Indicators Weather-related economic losses	Global inflation- adjusted losses rose an order of magnitude over the last 40 years. Part of the observed upward trend is linked to socio-economic factors and part is linked to climatic factors.

1. This table provides examples of key observed changes and is not an exhaustive list. It includes both changes attributable to anthropogenic climate change and those that may be caused by natural variations or anthropogenic Climate Change. Confidence levels are reported where they are explicitly assessed by the relevant Working Group.

Source: IPCC(2001).

The average rate of concentration in the past 2 decades was at the rate of 1.5 ppm (0.4%) per year but large annual fluctuations in the rate of increase of CO_2 concentrations can be observed. For example, in the 1990's, the annual rate of growth of CO_2 in the atmosphere varied between 0.9 ppm (0.2%) – 2.8 ppm (0.8%) with the highest increase coinciding with strong El Nino years.

Methane concentrations which account for 13% of the anthropogenic greenhouse effects, have increased from 770ppb (parts per billion) during the pre industrial era to 1610 ppb in 1983 and to 1745 ppb in 1998. The rate of concentration is estimated at 7.0 ppb/year, 50% of which is attributed to anthropogenic sources such as burning of biomass fuels, breeding of animals, wetland paddy cultivation and landfills.

Similarly, the atmospheric concentration of nitrous oxide (N_2O), is produced by the combustion of biomass and fossil fuels, chemical industries, increasing application of nitrogen fertilizers and eutrophicated water. The concentration of N_2O which was 270 ppb during the period 1000-1750, had increased to 316 ppb in 2000. It is a long lived GHG which increases at the rate of 0.2-0.3% per year in the lower atmosphere. The atmospheric concentrations of halocarbons are entirely anthropogenic and contain chloroflurocarbons (CFCs) and bromine (eg. halons) that lead to the depletion of ozone layer in the stratosphere but after 1994, the rate of concentration has declined. However, substitutes for CFCs such as hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) have been increasing. Further, current atmospheric concentrations of sulfer hexafluorides (SF_6) have also increased at the rate of 0.24ppt /yr. Although current concentrations are low, they have long atmospheric residence time. Hence, they have the potential to influence future climate. The radiative forcing (the change in the net vertical irradiance [expressed in Wm^{-2}] at the *tropopause* due to an internal change or a change in the external forcing of the *climate system*, such as, a change in the concentration of CO_2 or the output of the Sun) due to the increase of the well-mixed greenhouse gases for 1750-2000, was estimated to be $2.43Wm^{-2}$.

1.4 Changes during the 20th century due to global warming

Changes observed during the 20th century, as a consequence of global warming are indicated in Tables 1 and 2 include

a) A rise of global sea level by an average annual rate of 1-2 mm during the 20th century

b) Decrease of snow cover by 10%.
c) Intensification of the hydrological cycle and the increase of precipitation by 0.5 – 1.0 % per decade over most mid and high latitudes in the Northern Hemisphere.
d) Decrease of rain fall by 0.3 % per decade on the average, over much of the subtropical land areas. Over tropical lands, rainfall is likely to increase by 0.3% per decade.
e) Increase in the frequency and severity of drought in recent decades in parts of Asia and Africa.
f) Increase in the frequency and intensity of El Nino events during the last 2-3 decades (eg. the 1997-1998 El Nino event had caused considerable damage to human and physical systems).
g) Lengthening of the growing season by about 1-4 days per decade, during the last 4 decades in the Northern Hemisphere.
h) Earlier plant flowering, bird arrival, emergence of insects and earlier dates of the breeding season.
i) Increased frequency of coral reef bleaching, especially during El Nino events.

1.5 Projected climate change in the 21st century

All SRES scenarios and IS92a project the globally averaged temperature to increase by from 1.4°C to 5.8°C between 1990 and 2100. The projected increase from 1990- 2025 and 1990-2050 is 0.4-1.1°C and 0.8°C to 2.6°C respectively. The projected rate of warming is likely to be without precedent. CO_2 levels are projected to range between 540 ppm to 970 ppm. Uncertainties cause a variation of about –10% to +30% (Fig.6). Hence the total range is expected to vary from 490-1260 ppm. CO_2 emissions from fossil fuels would be the dominant factor in emission increases. The stabilization of atmospheric CO_2 concentration at 450 ppm, 650 ppm or 1000 ppm world require global anthropogenic CO_2 emissions to drop below 1990 levels within a) a few decades, b) about a century or c) about 2 centuries respectively and continue to decrease steadily thereafter. The model calculations of abundances of primary non-CO_2 greenhouse gases by 2100 also vary considerably across the 6 illustrative SRES scenarios.

1.6 Projections for future changes in precipitation and sea level

The global average precipitation is projected to increase in South and East Asia in summer, in northern and mid latitudes in tropical Africa and Antarctica in winter and in the high latitude regions in both summer and winter. Decreases in winter rainfall are projected in Australia, Central America and Southern Africa in winter. It is *likely*, that there will be an increase in the Asian summer monsoon precipitation variability.

The global mean sea level is projected to increase by 0.09m – 0.88m between 1990 and 2100 for the full range of SRES scenarios. The projected figures for 1990-2025 and 1990 and 2050 are 0.03-0.14m and 0.05-0.32m respectively.

1.7 Projections of extreme climate and weather events

Higher maximum temperatures, more hot days and heat waves are *very likely* over most land areas. Higher (increasing) minimum temperatures are *very likely*. The hydrological cycle would be most intense and more intense precipitation events (increase in amplitude and frequency of extreme precipitation events) are *very likely* over many areas while it is likely that there would be increased precipitation variability of the Asian Summer monsoon.

1.8 Potential impacts of climate change on developing countries

If no climate policy interventions are implemented, future climate changes would have adverse impacts on developing countries such as Sri Lanka. As indicated in IPCC publications, both natural and human systems are sensitive to, and sometimes highly vulnerable to climate change. Some of the adverse consequences of climate change in developing countries by 2025, if climate policy interventions are not adopted, are summarized below in Table 3.

Table 3 - adverse consequences of climate change in developing countries by 2025 – if no action taken

Physical and Human Systems	Potential Impacts in 2025 if no action is taken
	Since there is a close interrelationship between climate change and hydrological cycle, warmer temperatures could lead to the intensification of the hydrological cycle. These changes in turn - would affect water supply, river runoff, ground water recharge and storage. - degrade water quality. - would lead to increases in extreme hydrological events such as floods and droughts. - would increase the water demand from agriculture, power generation, domestic and industrial uses. - Sea level rise could cause increase saline intrusions into coastal aquifers.
Biological Systems	-Changes in species distributions, population sizes, timing of reproduction or migration. - Risks to unique and threatened systems. eg. loss of biodiversity; increased frequency of coral bleaching and death ; loss of coastal wetlands; changes in terrestrial ecosystems; loss of unique habitats; -shifts in ranges of plant and animal species; -increased frequency of ecosystem disturbance by fire and insect pests.
Agriculture and food security	- Adverse impacts of increased temperature on annual

	and perennial crops and livestock. eg. increase in temperature (greater than 35^0C for more than 1 hour) could cause spikelet sterility in rice and reduced formation of tubers and tuber bulking in potatoes. - Increased demand for irrigated water in areas where rainfall is expected to be reduced. - Increased CO_2 concentrations can stimulate crop growth and yield but will not be able to compensate for adverse effects of heat and drought. Further, yield gains are said to be smaller under field conditions. Higher yields further offset by increases in weeds and pests. - Destruction of crops by extreme events, declining incomes of farmers. Increases in food prices and malnutrition. - Declines in agricultural exports, fishing and agro-based industries.

Energy	- Increased energy demand for space cooling. - Reduced energy supply reliability of counties that are dependent on hydro electricity and biomass.
Human settlements	-Direct impacts on impacts on health, buildings and infrastructure. - Indirect impacts on productive capacity. The most vulnerable settlements would be where people are heavily dependent on natural resources or those located along the coast or in areas subject to landslides, droughts and floods.
Health	- Increase in heat related deaths and illnesses due to exposure to urban heat island effect. - Loss of life, injuries and psychological trauma in cyclone, landslide and flood affected areas. - Adverse effects of UV-B radiation on eyes and skin. - Expansion of areas of potential transmission of malaria, dengue and other vector borne diseases. - Increase in numbers affected by water borne and water washed and respiratory diseases. - Increase in malnutrition
Industry	- Agro-based industries and the tourist industry would be affected by electricity fluctuations and water shortages. - Natural hazards would lead to loss of infrastructure and access to shipments.

Adapted from IPCC (2001)

1.9 Convention on Climate Change

Scientists during the 1970s warn governments that increased concentration of greenhouse gases in our atmosphere is enhancing the natural greenhouse gas effect, causing the Earth to become warmer if current pattern of emission of greenhouse gas continues. Fortunately, the world community took this seriously and decided to investigate the problem and appointed the intergovernmental negotiating body to develop an international policy instrument to address the issue of global warming. The international negotiating body developed the United Nations Framework Convention on Climate Change (UNFCCC), which was adopted at the Rio Summit in 1992. It entered into force on 21 March 1994, after receiving the requisite 50 ratifications. Sri Lanka became a party to it in 1994. The Convention now has **186** parties and is approaching universal membership.

The objective of the UNFCC is to stabilize atmospheric green house gas concentration at a level that will prevent dangerous human interferences with the climate system. In developing the UNFCC it was found that there is a vast regional and country differences in the per capita emission of greenhouse gases. When look at the per capita emission of different countries, it is some times the difference is 50 times higher (Table 4). Per capita CO_2 emissions in metric tons in 1991 in Brazil 1.6, China 2.7, Czech Republic 10.9, Japan 9.0, Russian Federation 12.2, Swaziland 0.5, India 1.0, Malaysia 5.3, UK 9.3, USA 20.5, Sri Lanka 0.11. The USA emits 25% of total annual global emission, which is equivalent to`36% of the total emission of all industrialized Countries. Therefore the UNFCC was negotiated with the "Common but differentiated responsibility" principle. This means that those countries that emit more emission should do more than less emitting countries. Since the adoption of the UNFCCC in 1992, parties have continued to negotiate in order to agree on decisions and conclusions that will reduce global greenhouse gas emissions. Adoption of the Kyoto Protocol in 1997 is a landmark event in such negotiations.

Table 4– Per capita emission in South Asian Countries compared to USA

Country	**Per capita carbon emissions in tons**	
	1990	**1996**
USA	5.18	5.37
Bangladesh	0.04	0.05
Bhutan	0.02	0.04
India	0.22	0.29
Maldives	0.19	0.31
Nepal	0.01	0.02
Pakistan	0.16	0.18
Sri Lanka	0.06	0.11

1.10 Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change strengthens the international response to climate change. Adopted by consensus at the third session of the Conference of the Parties (COP-3) in December 1997 in Kyoto, Japan, it contains legally binding emissions targets for 39 developed countries (Annex 1 countries) for the post-2000 period. By arresting and reversing the upward trend in greenhouse gas emissions that started in these countries 150 years ago (Figure 1), the Kyoto Protocol promises to move the international community one step closer to achieving the Convention's ultimate objective of preventing "dangerous anthropogenic [man-made] interference with the climate system".

Under the Kyoto Protocol developed countries commit themselves to reducing their collective emissions of six key greenhouse gases by at least 5.2% from their total GHG emission in 1990. This group target will be achieved through emission cuts of 8% by most Central and East European states and the European Union (the EU will meet its target by distributing different rates among its member states); 7% by the US; and 6% by Canada, Hungary, Japan, and Poland. Russia, New Zealand, and Ukraine are to stabilize their emissions, while Norway may increase emissions by up to 1%, Australia by up to 8%, and Iceland 10%. Table 5 gives the emission reduction targets of 39 countries.

Table 5 – Emission reduction targets under the Kyoto Protocol

Country	Total Emissions (Gg) 1n 1990	Emission Reduction % from total (Percentage of base year or period)
Australia	59,200	+8
Austria	288,965	-8
Belgium	113,405	-8
Bulgaria	82,990	-8
Canada	457,441	-6
Croatia	—	-5
Czech Republic	169,514	-8
Denmark	52,100	-8
Estonia	37,797	-8
European Community	—	-8
Finland	53,900	-8
France	366,536	-8
Germany	1,012,443	-8
Greece	82,100	-8
Hungary	71,673	-6
Iceland	2,172	+10
Ireland	30,719	-8
Italy	428,941	-8
Japan	1,173,360	-8
Latvia	22,976	-8
Liechtenstein	208	-8
Lithuania	—	-8
Luxemburg	11,343	-8

Monaco	71	-8
Netherlands	167,600	-8
New Zealand	25,530	0
Norway	35,533	+1
Poland	414,930	-6
Portugal	42,148	-8
Romania	171,103	-8
Russian Federation	2,388,720	0
Slovakia	58,278	-8
Slovenia	—	-8
Spain	260,654	-8
Sweden	61,256	-8
Switzerland	43,600	-8
Ukraine		0
United Kingdom of Great Britain and Northern Ireland	584,078	-8
United States of America	4,957,022	-7

Note: countries with – sing should reduce their emissions while countries with + sign can increase by that percentage.

The six gases, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) are to be combined in a "basket", with reductions in individual gases translated into "CO_2 equivalents" that are then added up to produce a single figure. Each country's emissions target must be achieved by the period 2008-2012. It will be calculated as an average over the five years. "Demonstrable progress" must be made by 2005. Cuts in the three most important gases – carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_20) - will be measured against a base year of 1990 (with exceptions for some countries with economies in transition). Cuts in three long-lived industrial gases – hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6) - can be measured against either a 1990 or 1995 baseline. (A major group of industrial gases, chlorofluorocarbons, or CFCs, are dealt with under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer.) No emission reduction commitments for developing countries. Therefore Sri Lanka has no commitment under the Kyoto Protocol.

On 16 February 2005 the Kyoto Protocol entered into force after it receiving the threshold number of ratifications. All member countries of European Union, Japan, Norway, Iceland, South Africa, Brazil, India, Sri Lanka and Russia have ratified the protocol by February 2005 . The United State of America has withdrawn from the Kyoto Protocol stating that it does not have scientific bass.

1.11 Flexibility mechanism

The Kyoto protocol introduced three flexibility mechanisms for developed countries to implement their emission reduction targets. They are Clean Development mechanism (CDM), Joint Implementation (JI), and Emission Trading (ET).

Clean Development mechanism (CDM) is defined in the Kyoto Protocol (Article 12) as a mechanism for North- South cooperation. The objective of the CDM is to "assist parties included in Annex 1 in achieving compliance with their quantified emission limitations and reduction commitments under Article 3" and to support "sustainable development" in developing countries. The Clean Development Mechanism (CDM) and associated carbon trading between developed and developing countries have received great international attention since it is the only mechanism that both developed and developing countries can participate. Under Article 6 of the Kyoto Protocol, Jointly Implemented projects that limit or reduce emissions or enhance sinks are permitted among developed countries.

Joint Implementation (JI) would allow developed countries and their companies to cooperate on projects that reduce GHG emissions and share the Emission Reduction Units (ERUs). Only developed countries can implement JI projects and developing countries cannot participate.

Article 17 of the Kyoto Protocol allows developed countries (Annex B) to exchange emissions obligations, leading to **Emission Trading (ET**). Emission Trading is "a market-based approach to achieve environmental objectives that allows those reducing Green House Gas (GHG) emissions below what is required to use or trade the excess reductions to offset emissions at another source inside or outside the country. Trading can occur at local, international and intra -company levels" but only developed countries can participate.

1.12 Modalities, Rules and Guidelines for Clean Development Mechanisms

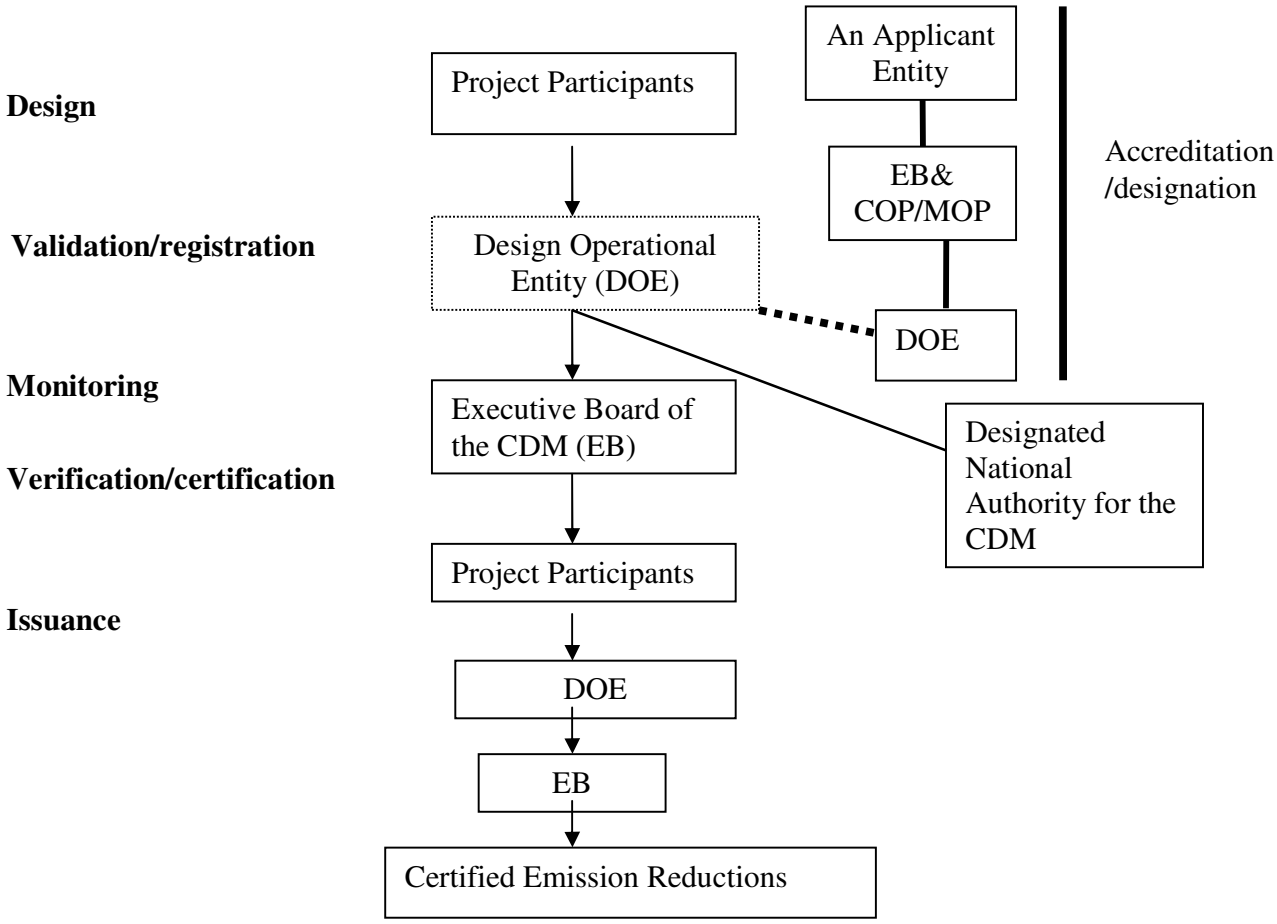
Since the adoption of Kyoto Protocol at the COP3 held in Kyoto, Japan it took many years for parties to develop the CDM rules and procedures to the level sufficient to implement. . The rules and procedure of the CDM have been now mostly finalized with the adoption of Marrakech Accord, the decision 17/CP.17 by the COP 7 and the decisions of the first COP/MOP meeting, 2/CMP.1, 9/CMP.1, 11/CMP.1, 13/CMP.1, 15/CMP.1, 16/CMP.1, 19/CMP.1, 20/CMP.1, 22/CMP.1 by the COP/MOP1. Yet, there are enormous ambiguities in interpretation, lack of clear guidance. The CDM Executive Board under the COP/MOP is continuously find solutions to most unresolved issues.

At COP 4 held in Buenos Aires, in November 1998, Parties adopted the so-called "Buenos Aires Plan of Action", setting out a program of work both to advance the implementation of the Convention and to flesh out the operational details of the Kyoto Protocol particularly carbon trading and CDM. This program of work was concluded at COP 5 held in Bonn in October/November 1999. At COP 6 held in The Hague, November 2000, Parties were unable to reach agreement on a package of decisions on all issues under the Buenos Aires Plan of Action at that session mainly due to the USA withdrawing from the Kyoto Protocol. Nevertheless, they decided to meet again in a resumed session of COP 6 to try once more to resolve their differences. At COP 6 part II

(Bonn, July 2001), Parties finally succeeded in adopting the Bonn Agreement on the Implementation of the Buenos Aires Plan of Action, registering political agreement on key issues under the Buenos Aires Plan of Action which resolved most of the issues on carbon trading and CDM. At the COP 7 held in Marrakech in November 2001 adopted the Marrakech Accord Declaration which further clarified issues related to CDM and Kyoto Protocol as a whole. The first session of the COP/MOP1 held from 28 November to 10 December 2005 by adopting decisions 2/CMP.1, 9/CMP.1, 11/CMP.1, 13/CMP.1, 15/CMP.1, 16/CMP.1, 19/CMP.1, 20/CMP.1, and 22/CMP.1 has given further guidance to implement the CDM activities.

The Marrakech Accord agreed the CDM Project Cycle for the implementation purpose (Figure 2). The figure 3 presents the CDM project development cycle for Sri Lanka.

Figure 2 - CDM Project Activity Cycle



1.13 Project Design

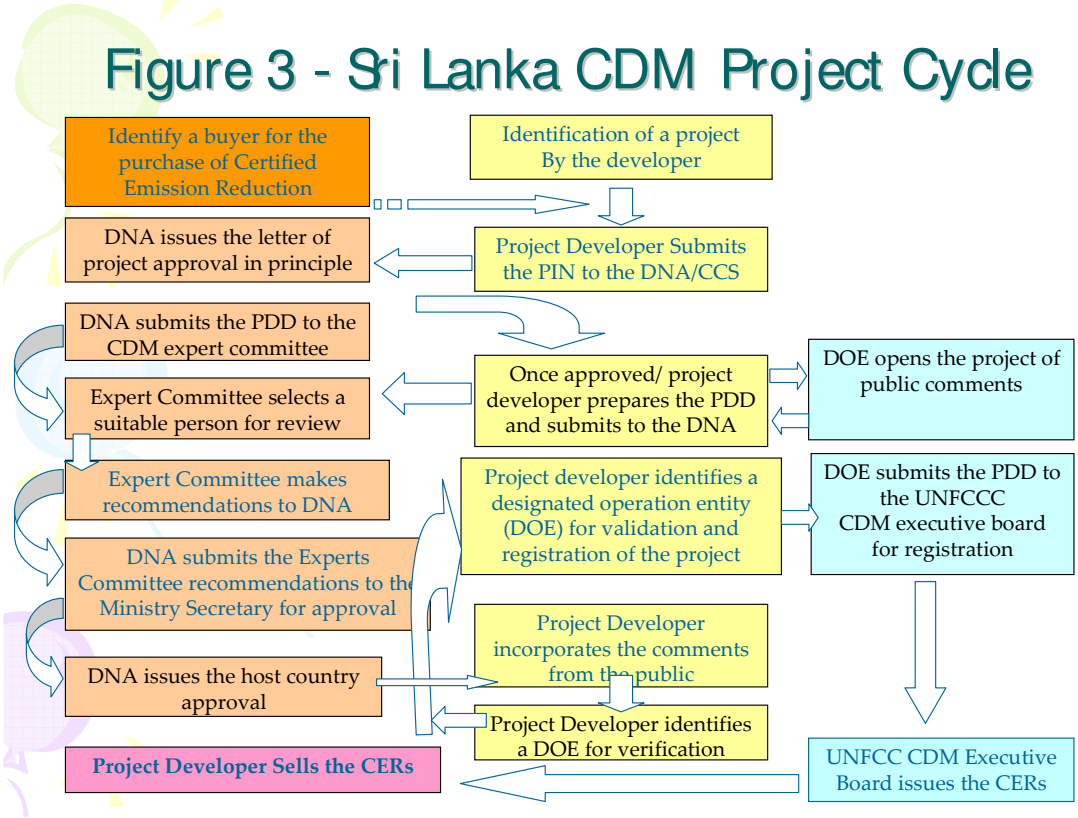
1.13.1 CDM eligibility requirements for Sri Lanka

A developing county is eligible for participation of CDM if following requirements are met:

- Voluntary participation
- The establishment of Designated National Authority
- Ratification of the Kyoto Protocol and become a Party to the Protocol

Since both these requirements have been met Sri Lanka is eligible for participation of CDM project activities.

Figure 3 - Sri Lanka CDM project development cycle



1.13.2 Project Identification

A project that should result in emission reductions or emission avoidance that would not have happened otherwise can be eligible as CDM projects. The project that has been identified as a CDM project should generate real, measurable and long-term climate change benefits and should contribute to the sustainable development of the host country.

Parties involved should approve the project and credits potentially earned from 2000 onward (through 2008-2012).

The Kyoto Protocol stipulates several criteria that CDM projects must satisfy. Two such critical criteria are additionality and sustainable development.

1.13.3 Project Idea Note (PIN)

The first step of project design is the preparation of a Project Idea Note (PIN) or Project Concept Note (PCN). This is the preliminary step to the PDD. Though this is not a statutory requirement most project developers prepare a concise project idea note with two objectives. One is to make sure the project concept is eligible for a CDM project. The other objective is to find a buyer for CERs before further investing on the project development. The PIN can be used to market the project. Different CERs buyers use different format for PIN preparation. The format for PINs can be obtained form the DNA and other CERs buyers such as the World Bank and JIBIC.

1.13.5 Project Design Document (PDD)

In order to get a CDM project approved and registered by the Executive Board (EB), the project participants must prepare a Project Design Document (PDD). This is a mandatory requirement under the UNFCCC CDM guideline. The PDD should be prepared using the outline and format approved by the CDM Executive Board. This format is being continuously improved and changed so that developers should make sure to use most recent version of PDD format shown on the CDM website of UNFCCC Secretariat (http://cdm.unfccc.int/Reference/Documents

The table 6 presents the contents of the PDD for the small scale CDM projects according to the recent version of the PDD guideline. For large scale CDM PDD there are two additional annexes. The CDM Executive Board provides guidelines for completing the PDD. Separate guidelines have been developed for completing small scale PDDs, large scale PDDs and Afforestation and reforestation sector PDDs. Since these guidelines are updated regularly, most recent guidelines should be used. These guidelines are available at the UNFCCC CDM website http://cdm.unfccc.int/Reference/Documents. While project developers themselves can prepare PDDs using these guidelines, it is advisable to obtain the services of an experience person in preparing PDDs.

Table 6 -Contents of Project Design Document (CDM-SSC-PDD)

	Sections
A.	General description of the small-scale project activity

B. Application of a baseline methodology

C. Duration of the project activity/Crediting period

D. Application of a monitoring methodology and plan

E. Estimation of GHG emissions by sources

F. Environmental impacts

G. Stakeholders' comments

Annex 1: Contact information on participants in the project activity

Annex 2: Information regarding public funding

The UNEP has identified several key pitfalls of PDDs that delay the process as follows:

- Lack of logic and consistency in PDD
- Deviations from selected calculations methodology not justified sufficiently or incorrect formulas applied
- Compliance with local legal requirements not covered sufficiently
- Insufficient information on the stakeholder consultation process
- Project participants not identified clearly
- The modalities of communication with Executive Board in terms CERs issuance and allocation instructions not stated clearly, or not signed by all project participants.
- Insufficient description on the technology
- Insufficient explanation of baseline scenario
- Insufficient explanation of project additionality
- Baseline information not sufficiently supported by evidence and/or not referenced sufficiently
- Major risks to the baseline not identified//described
- The project boundaries not identified clearly
- Project and/or crediting start date unclear
- Deviations from monitoring methodology not justified sufficiently
- Monitoring and project management procedures not defined

Project developers must make sure these pitfalls are addressed when developing PDDs.

1.14 Additionality

Additionality: Article 12 of the Kyoto Protocol states that projects must result in "reduction in emissions that are additional to any that would occur in the absence of project activity". The CDM project must lead to real, measurable, and long-term benefits related to the mitigation of climate change. Additional emissions reductions are calculated against the defined baseline. In order to qualify for a CDM project, the project proponent should prove that the project is additional to business as usual scenario. In other word, the project proponent must prove that in the absence of CDM, the project would not have occurred. A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

At its 15th meeting the CDM Executive Board adopted "Tool for Demonstration of Additionality" (Annex 3 to the report). This document was amended at the Executive Board's 16th meeting and further amended at its 17th meeting. Decision 12/CP.10, Guidance relating to the clean development mechanism points out, in paragraph 9, that as indicated by the Executive Board in paragraph 3 of the "Tool for Demonstration and assessment of Additionality" (Annex 1 of the Report of the Executive Board on its 16th meeting) said tool is not mandatory for project participant. However, it is advisable to follow the latest of "Tool for Demonstration and assessment of Additionality" version 2 dated 28 November 2005. In the case of small scale CDM projects, Attachment A to Appendix B to the simplified modalities and procedures for small scale CDM project activities should be followed. These documents may be revised frequently. Therefore most recent version should be downloaded from the CDM website, www.unfccc.int/cdm.

The latest version of the "Tools for the demonstration and assessment of additionality" , version 2) dated 28 November 2005 recommends following steps to demonstrate project additionality:

Step 0 – Preliminary screening based on the starting date of the project activity

If project participants wish to have crediting period starting prior to the registration of the project activity, the step 0 is relevant.

Step 1 – Identification of alternatives to the project activity consistence with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

Project developer should define credible alternatives to proposed project including project activity is not undertaken. If there is no alternative the project is not additional.

Sub step 1b – Enforcement of applicable laws and regulations:

The alternatives identified should comply with all applicable legal and regulatory requirements. Otherwise the proposed project activity is not additional.

Step 2. Investment analysis

This is to prove that the proposed project activity is economically or financially less attractive than other alternatives. If at least one alternative identified is economically or financially less attractive than the proposed project, the project is not additional.

Sub-step 2a. Determine appropriate analysis method

Simple cost analysis, investment comparison analysis, or benchmark analysis can be used.

Sub-step 2b – Option 1 - Apply simple cost analysis

I the project produce no economic benefits other than CDM related income simple cost analysis can be used. Otherwise other investment analysis methods should be used.

Sub-step 2b – Option II - Apply investment comparison analysis

Use appropriate financial indicators, such as IRR, NPV, cost- benefits ratio or unit cost of service etc.

Sub-step 2b – Option III – Benchmark analysis

Financial indicators may be used to represent the standard returns in the market.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to option II)

Compare other alternatives using the selected financial indicators.

Sub-step 2d.- Sensitivity analysis (only applicable to option II and III)

Sensitivity analysis is undertaken to show whether the conclusion regarding the financial attractiveness is robust to reasonable variations so that the financial argument is in favor of additionality.

Step 3 – Barrier analysis

This step demonstrates that the project faces some barriers and these barriers do not prevent other alternatives.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

This includes investment barriers, technology barriers etc. that prevent the proposed project.

Sub –step 3b – Demonstration that the identified barriers would not prevent the implementation of alternatives

Above barriers to the project should not prevent at least one alternative identified.

Step 4 – Common practice analysis

This is a credibility check to complement investment analysis through investigating that whether similar project are common in the country or in the region.

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

This should provide an analysis of any other activities implemented previously or currently that are similar to the proposed project activity.

Sub-step 4b – Discuss any similar options that are occurring

If similar activities are common in the area how the proposed project faces barriers.

Step 5 – Impacts of CDM registration

This step demonstrates how by registering this project as a CDM project can remove the barriers proposed above.

1.15 Sustainable development criteria

The Kyoto Protocol specifies that the purpose of the CDM is to assist developing countries in achieving sustainable development. The Protocol does not provide a guideline to define sustainable development. It is up to the developing countries to determine their own criteria and assessment process for sustainable development. In general many countries use three main criteria for defining sustainable development: Social criteria, Economic criteria and Environmental Criteria. The criteria approved by the government of Sri Lanka can be obtained from the Ministry of Environment which is the DNA.

1.16 Baseline scenario

The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A within the project boundary. A baseline shall be deemed to reasonably represent the anthropogenic emissions by sources that would occur

in the absence of the proposed project activity if it is derived using a baseline methodology referred to in paragraphs 37 and 38 of the CDM modalities and procedures (17/CP.7). Simplified baseline scenarios for a small-scale CDM project activity has been specified in Appendix B to the simplified modalities and procedures for small scale CDM project activities.

A baseline shall be established: (a) By project participants in accordance with provisions for the use of approved and new methodologies, contained in decision 17/CP.7; (b) In a transparent and conservative manner regarding the choice of approaches, assumptions, methodologies, parameters, data sources, key factors and additionality, and taking into account uncertainty; (c) On a project-specific basis; (d) In the case of small-scale CDM project activities which meet the criteria specified in decision 17/CP.7 and relevant decisions by the COP/MOP, in accordance with simplified procedures developed for such activities; (e) Taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector.

1.17 Baseline approach

The baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host Party. The baseline approach shall be defined in a way that CERs cannot be earned for decreases in activity levels outside the project activity or due to force majeure. A baseline approach is the basis for a baseline methodology. In choosing a baseline methodology for a project activity, project participants shall select from among the following approaches as identified in sub-paragraph 48 (a) to (c) of the modalities and procedures of CDM, the one deemed most appropriate for the project activity, taking into account any guidance by the executive board, and justify the appropriateness of their choice: (a) Existing actual or historical emissions, as applicable; or (b) Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment; or (c) The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

1.18 Baseline methodology

A methodology is an application of an approach as defined in paragraph 48 of the CDM modalities and procedures, to an individual project activity. In developing a new methodology, the first step is to identify the most appropriate approach for the project activity and then applicable methodology.

Project baselines are described as the amount of Green House Gas (GHG) emissions (or sequestration) in a given time and a place, in absence of CDM/ JI project, against which the emission reduction (or GHG sink) benefits achieved by the project, would be measured.

The major practical challenge associated with baseline determination is the hypothetical nature of the baseline and some unavoidable uncertainties associated with it. Any emission reduction (due to a CDM project) should be "additional" to those that would occur in the entire economy, in the absence of the project (i.e. "Emissions Additionality or "Environmental Additionality"). A primary challenge under the environmental additionality requirement is to consider the indirect emission effects of a specific CDM/JI investment of project, such as leakage. Therefore CDM/JI projects needs to identify suitable system boundaries within which all direct GHG emissions both in the CDM project and baseline case should be measured and direct leakage should be avoided.

1.19 Baseline for small-scale CDM project activities

Small scale CDM project can use the approved baseline methodology by the Executive Board and included in an indicative list of simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. The list of approved methodologies is contained in the Appendix B to the simplified modalities and procedures for small-scale CDM project activities (Table 7). This can be found at the website (http:/cdm.unfccc.int/methodologies/SSCmethodologies/approved).

Table 7 - Approved small scale methodologies

Reference	Methodologies Title (including baseline and monitoring methodologies)	Sectoral Scope
AMS-I.A.	Electricity generation by the user	1
AMS-I.B.	Mechanical energy for the user	1
AMS-I.C.	Thermal energy for the user	1
AMS-I.D.	Grid connected renewable electricity generation	1
AMS-II.A.	Supply side energy efficiency improvements – transmission and distribution	2
AMS-II.B.	Supply side energy efficiency improvements – generation	1
AMS-II.C.	Demand-side energy efficiency programs for specific technologies	3
AMS-II.D.	Energy efficiency and fuel switching measures for industrial facilities	4
AMS-II.E.	Energy efficiency and fuel switching measures for buildings	3

AMS-II.F.	Energy efficiency and fuel switching measures for agricultural facilities and activities	3
AMS-III.A.	Agriculture	
AMS-III.B.	Switching fossil fuels	1
AMS-III.C.	Emission reductions by low-greenhouse gas emitting vehicles	7
AMS-III.D.	Methane recovery in agricultural and agro industrial activities	10 , 13
AMS-III.E.	Avoidance of methane production from biomass decay through controlled combustion	13 , 15
AMS-III.F.	Avoidance of methane production from biomass decay through composting	13
AMS-III.G.	Landfill methane recovery	13
AMS-III.H.	Methane recovery in wastewater treatment	13 , 15
AMS-III.I.	Avoidance of methane production in wastewater treatment through replacement of anaerobic lagoons by aerobic systems	13 , 15

1.20 Crediting period

The crediting period is the period for which the credits for emission reductions are expected.
Project participants shall select a crediting period for a proposed project activity from one of the following alternative approaches: a) A maximum of seven years which may be renewed at most two times, provided that, for each renewal, a designated operational entity determines and informs the executive board that the original project baseline is still valid or has been updated taking account of new data where applicable; or (b) A maximum of ten years with no option of renewal.

1.21 Leakage

Reductions in anthropogenic emissions by sources shall be adjusted for leakage in accordance with the monitoring and verification. Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and which is measurable and attributable to the CDM project activity. For

example, if a project displaces a group of people who started to cut forest elsewhere, this increases GHG emissions. Though this forest clearance is not a part of the project activity, it is an indirect outcome of the project. Therefore for these type of indirect impacts should be estimated as leakages. Leakage should be added to the project emissions.

1.22 Validation

Validation is the process of independent evaluation of a project activity by a designated operational entity (OE) against the requirement of the CDM as set out in decision 17/CP.7, the CDM modalities and procedures and relevant decisions of the COP/MOP, on the basis of the project design document. Independent operational entity (OE) validates the PDD and will issue a letter to the CDM executive board certifying that t the project meet the requirement of CDM.

Written confirmation from each national authority should be obtained before validating a project. The operational entity will make the project documents publicly available for public comments for a period of 30 days. After 30-day posting for public comments OE makes a decision on validation, and submits a report to the Executive Board, requesting validation and registration of the project.

1.23 Registration

Registration is the formal acceptance by the Executive Board of a validated project activity as a CDM project activity. Validation is a prerequisite for the validation. Registration by the Executive Board will be completed in 8 weeks after receiving the validation report and registration request from OE. If there is an objection or clarification raised by a member this can delay. Registration is the prerequisite for the verification, certification and issuance of CERs related to that project activity. A registration fee should be paid at the time of registration as a share of proceeds to cover administrative expenses (SOP- Admin) of clean development mechanism. This is equivalent to USD 0.10 per certified emission reduction issued for the first 15,000 tones of CO_2 equivalent in a given calendar year. USD 0.20 per certified emission reduction issued for any amount in access of 15,000 tones of CO_2 equivalent in a given calendar year. However, the maximum registration fee payable based on this calculation shall be USD 350,000. No registration fee has to be paid for CDM project activities with expected average annual emission reduction over the crediting period below 15,000 t CO_2 equivalent.

1.24 Verification

Verification is periodic independent review by OE of monitored reductions in emissions. After the emission reduction is taken place, the OE inspects and verifies how much emissions have been actually reduced. Operational entity should provide verification report to project participants, Parties involved, and Executive Board (EB).

1.25 Certification

Having verified the emission reductions, Operational Entity provides certification report to EB, requesting issuance of Certified Emission Reduction (CERs). Within 30 days, EB informs project participants of its decision regarding issuance of CERs. Based on certification report of the OE, the EB issues the CERs.

1.26 Monitoring and Verification Plan

CDM project proponent must develop a plan to measure emissions within the project boundary and a plan to measure emissions outside the project boundary that are significant and reasonably attributable to the project activity. These monitoring plans must be approved by CDM the Executive Board. The OE uses the information in the monitoring pan for verification of emission reductions.

1.27 Designated operational entity

The designated operation entity (DOE) is an independent agency accredited by the Executive Board for independent validation, verification and certification of CDM projects. The DOE are accredited to validate or verify CDM projects in 15 sectoral scopes. A DOE can be accredited for one or several scopes or specific to a particular region depending on its technical capability. The table 8 presents the list of DOEs accredited and their sectoral scopes.

The designated operational entity selected by project participants to validate a project activity, being under a contractual arrangement with them, shall review the project design document and any supporting documentation to confirm that the following requirements have been met: a) The baseline and monitoring methodologies comply with requirements pertaining to: (i) Methodologies previously approved by the executive board; or (ii) Modalities and procedures for establishing a new methodology. If the designated operational entity determines that the project activity intends to use a new baseline or monitoring methodology, it shall, prior to a submission for registration of this project activity, forward the proposed methodology together with the draft project design document, including a description of the project and identification of the project participants to the executive board for review. The executive board shall expeditiously, if possible at its next meeting but not later than four months, review the proposed new methodology in accordance with the modalities and procedures of the present annex. Once approved by the executive board it shall make the approved methodology publicly available along with any relevant guidance and the designated operational entity may proceed with the validation of the project activity and submit the project design document for registration. In the event that the COP/MOP requests the revision of an approved methodology, no CDM project activity may use this methodology. The project participants shall revise the methodology, as appropriate, taking into consideration any guidance received.

Table 8 – List of Designated Operation Entity and their Sectoral Scope

Ref. Number	Entity Name (short name)	Sectoral scopes for validation	Sectoral scopes for verification and certification
E-0001	Japan Quality Assurance Organization (JQA)	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13	
E-0002	JACO CDM.,LTD (JACO)	1, 2, 3	
E-0003	Det Norske Veritas Certification Ltd. (DNVcert)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15
E-0005	TUV Industrie Service GmbH TUV SUD GRUPPE (TUV Industrie Service GmbH TUV)	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14, 15	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 15
E-0006	Tohmatsu Evaluation and Certification Organization Co., Ltd. (TECO)	1, 2, 3	
E-0007	Japan Consulting Institute (JCI)	1, 2, 13	
E-0009	Bureau Veritas Quality International Holding S.A. (BVQI Holding S.A.)	1, 2, 3	1, 2, 3
E-0010	SGS United Kingdom Ltd. (SGS)	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 15	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 15
E-0011	The Korea Energy Management Corporation (KEMCO)	1	
E-0013	TÜV Industrie Service GmbH, TÜV Rheinland Group (TÜV Rheinland)	1, 2, 3, 13	
E-0014	KPMG Sustainability B.V. (KPMG)	1, 2, 3	
E-0018	British Standards Institution (BSI)	1, 2, 3	

E-0021	Spanish Association for Standardisation and Certification (AENOR)	1, 2, 3	1, 2, 3
E-0022	TÜV NORD CERT GmbH (RWTUV)	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13	1, 2, 3
E-0025	Korean Foundation for Quality (KFQ)	1, 2, 3	
E-0029	PricewaterhouseCoopers - South Africa (PwC)	1, 2, 3	

1.28 CDM in forestry sector

Forest sector accounts for 20% of the global CO_2 emissions at 1.6 GtC annually. Therefore Land Use Land use changes and forestry (LULUCF) sector has potential to mitigate 2 GtC per year. However, only afforestation and reforestation projects are eligible for CDM according to Bonn Agreement. Marrakesh Accord sets limits on CERs from Afforestation and Reforestation activities at 1% of the base year emission of the Party times five. So far only 4% of total CERs are from LULUCF sector. Most of the LULUCF projects are outside the Kyoto mechanism.

1.28.1 Afforestation

Direct human induce conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human induced promotion of natural seed sources

1.28.2 Reforestation

Direct human induced conversion of non-forested land to forested land through planting, seeding or human induced promotion of natural seed sources on land that was forested but that has been converted to non-forested land prior to 31st December 1989. For the first commitment period (2008 –2012), reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31st December 1989.

1.28.3 Non-permanence

Forestry CDM project should address the issue of non-permanence. This means that forest absorbs carbon temporarily. Once forest is destroyed the carbon will be released to the atmosphere. In order to address the non-permanence issue, system of temporary

certified emission reductions tCERs and long- term certified reductions (lCERs) have been introduced.

1.28.4 Eligible forest CDM Projects under Bonn Agreement

- Establishment of woodlots on communal lands.
- Reforestation of marginal areas with native species eg: riverine areas, steep slopes, around and between existing forest fragments (Through planting and natural regeneration).
- New large-scale, industrial plantations.
- Establishment of biomass plantations for energy production and the substitution of fossil fuels.
- Small-scale plantations by landowners
- Introduction of trees in to existing agricultural systems (agroforestry).
- Rehabilitation of degraded areas through tree planting or assisted natural regeneration.

1.29 Major decisions in the Marrakech Accords related to CDM

- Fungibility, allowing emissions units under all three mechanisms to be treated equally. This allows for a more liquid market in emissions units, making it more viable and enhancing opportunities for cost-effectiveness.

- Creation of a new removal unit (RMU) to represent sinks credits (Including through JI). RMUs can be used only to meet a party's emissions target in the commitment period in which they are generated. They cannot be banked for future commitment period.

- Banking on any remaining emissions allowances beyond those needed to meet a party's target is permitted. Banking of credits generated under CDM or JI is limited to 2.5% of a party's initial assigned amount.

- Unilateral CDM is allowed, enabling developing countries to undertake CDM Projects without an Annex I partner and market the resulting emissions credits in the world market.

- Annex I parties that cannot meet the Protocol's inventory requirements can still host JI projects through a project design and approval process similar to the CDM.

- The CDM executive Board is authorized to approve methodologies for baselines, monitoring plans and project boundaries; accredit operational entities; and develop and maintain the CDM registry. The COP/MOP will oversee rules of procedure for the executive board; accreditation standards for, and designation of,

operational entities; and a review of regional/sub-regional distribution of CDM project activities.

CHAPTER 2 - REVIEW THE INTERNATIONAL CARBON MARKET AND PROGRESS OF VARIOUS FLEXIBLE MECHANISMS UNDER KYOTO PROTOCOL TO IDENTIFY SPECIFIC NICHES FOR SRI LANKA

The Kyoto Protocol has been designed to reduce combined GHG emissions by 5.2 % below 1990 levels in the commitment period 2008-2012. This has created the demand for total GHG reductions up to 5.0 to 5.5 billion tons CO2e. Thirty eight developed countries and countries in economies in transition have agreed to make these reductions.

The regulatory framework of the carbon market has established considerably with the entry into force of the Kyoto Protocol on February 16, 2005. With the registration of more than 300 Clean Development Mechanism (CDM) projects by the CDM Executive Board, the approval of climate mitigation plans in Japan and Canada, and the allocation plans under the ED ETS for the 2008-2012 period, the very existence of policies constraining GHG emissions up to 2012 is no longer in doubt. The CDM market is now certain. However, there are still uncertainly regarding the size of the market which is decided by the marginal abatement cost (MAC) of emission reduction.

2.1 Economic Theories of flexibility mechanisms

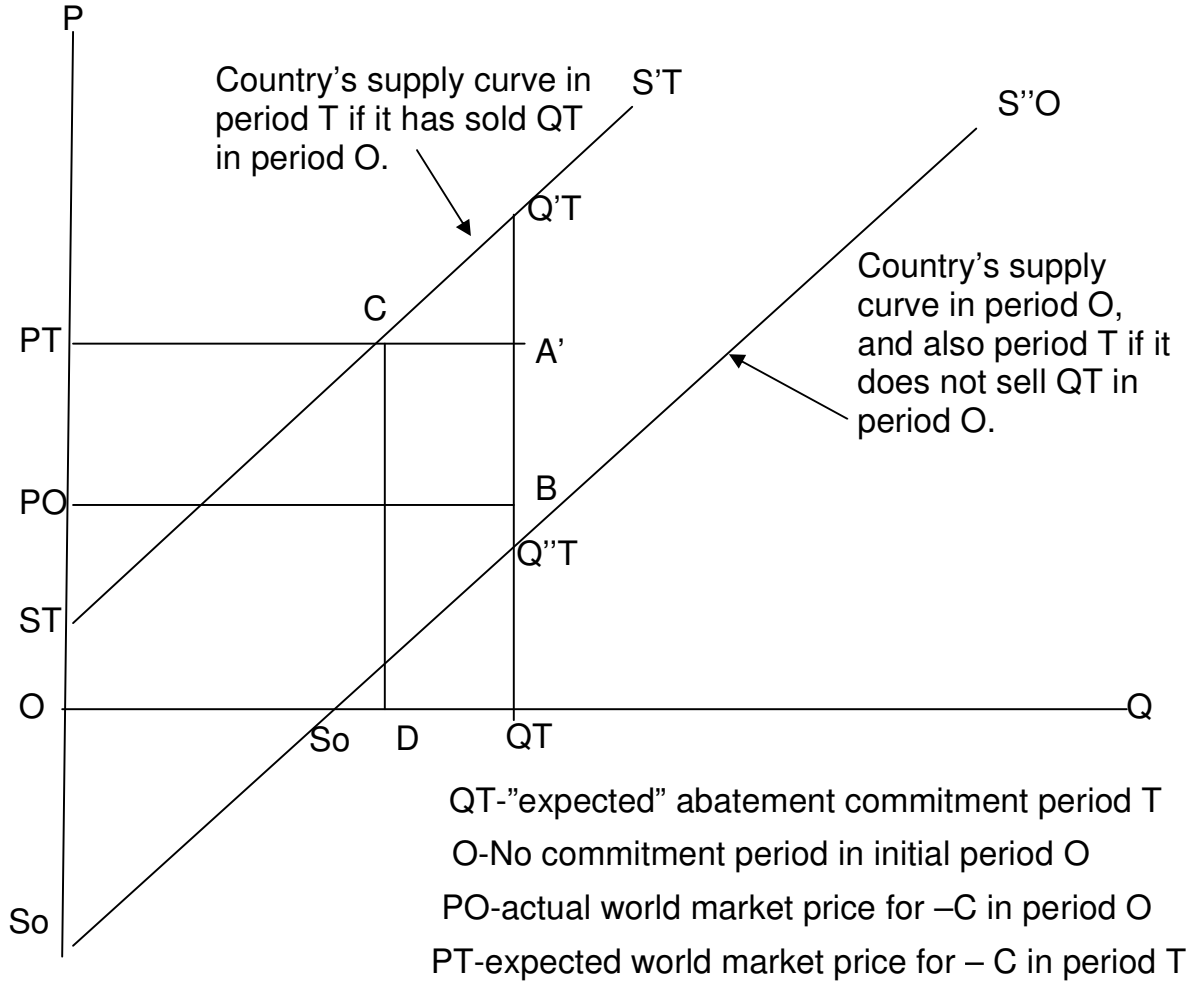
Emission trading is possible because the marginal Green House Gas Abatement cost (MAC) varies from one country to another and one region to another this means that Emission trading cannot be implemented if MAC of all polluting firms equal. If a country A is required to abate emission by law, it can either abate emission itself or purchase emission abatement from country B whose (MAC) is lower than firm A. This provides least cost option to produce emission abatement for the world as a whole.

When product (e.g. Electricity) is supplied at least cost by a given technical option (e.g. Coal based power generation) which emit GHGs, then the replacement of this option to supply the same quality of electricity by another option (e.g. natural gas based power generation) that emit less GHG will involve extra cost. Since both technical options produce same quantity of electricity, the difference between the quantity of GHG emitted by the coal based option and the quantity emitted by the gas based option (abatement option) is the quantity of abatement produced. The difference in the MACs of two options is the marginal abatement cost of GHG abatement, and it is expressed in terms of Rupees per tonne of emission abated.

There are instances where GHG abatement can be undertaken at negative cost, for example incandescent bulbs due to technological efficiency. This improved systematic efficiency of two commodities can be used to produce GHG abatement. This would result in GHG abatement at negative cost, because the abatement option can be profitable to

undertake without considering the GHG abatement released. In the figure 4, the supply curve SO – S'O illustrates the negative cost abatement options.

Figure 4 - Abatement cost emission reduction in different time period



It is also possible to undertake GHG abatement taking the advantage of regional cost differences. For example GHG abatement may be undertaken in Sri Lanka at cheaper rate than in United State even using same technology.

2.1.1 Marginal abatement costs (MAC)

If we take world situation, there are negative cost GHG abatement options and positive GHG cost abatement options. The demand and supply of GHG under negative and positive cost options are different. When the GHG abatement requirement increases, the negative cost options can be expected to exhaust first, then other positive cost option in

order of increasing marginal abatement cost. Then the marginal abatement cost curve shift to the left (Figure 1). Similarly low cost region draws higher GHG abatement activities than high cost regions. In all these situations MAC plays a significant role. Figure 1 illustrates that if abatement is not done today and keep those options for future abatement the MAC curve will shift to right. This may increase the over all cost in the future. Table 9 present some abatement cost estimates of selected power sector CDM projects.

Table 9 - Marginal abatement costs estimates of selected power projects

Country/Region	**Candidate CDM Projects**	**Increase in abatement cost (10^6US$)**	**Marginal abatement cost (US$/tonne)**	Emission reduction		
				CO_2 (10^6 tonnes)	**SO_2 (10^3 tonnes)**	**NO_X (10^3 tonnes)**
Indonesia	Geothermal Solar PV	27.0 106.0	21.1 60.0	15.7 20.6	-5.1 -18.0	0.1 0.03
NERB-India	BIGCC Solar PV	1,884.6 -254	346.3 1336.1	55.5 13.5	26.4 -21.8	47.9 25.4
Sri Lanka	IGCC PFBC CC-LNG Wind Dendro	63.0 39.9 149.9 78.8 88.5	303.0 422.0 112.0 133.0 176.0	2.0 0.8 15.3 5.9 6.2	48.7 42.8 68.4 12.0 11.9	164.2 167.5 145.0 180.9 181.1
Thailand	IGCC PFBC BIGCC Mini- hydro	35.0 77.0 137.0 -23.0	44.8 368.1 11.0 8.0	10.0 4.0 101.0 12.0	224.0 140.0 868.0 172.0	73.0 53.0 159.0 17.0
Vietnam	PFBC Hydro Geothermal	288.8 23.2 33.5	18.0 339.0 268.8	12.2 10.3 1.3	6.0 9.0 0.0	36.0 35.0 5.0
Vietnam	IGCC CFBC Wind Geothermal	78.5 52.3 87.7 61.7	59.0 57.2 41.4 18.0	9.2 6.1 10.4 19.6	184.7 183.1 75.3 140.0	42.0 30.7 22.9 42.4
	Solar PV	94.8	43.6	10.2	73.1	22.7

Source: ARRPEC 2002

2.1.2 CDM transaction costs

CDM projects incur relatively large fixed transaction costs prior to registration. This means that projects must be relatively large to be economically viable. Analytical studies suggest a minimum project size of 50000 tCO_2eq per year. It has been suggested

that the *minimum* size is about 100 000 tCO_2e per year. The *average* size of existing and identified projects is over 150000 tCO_2e per year. The minimum size of an economically viable project may decline over time as more approved baseline and monitoring methodologies become available. Those methodologies will reduce the fixed component for the transaction costs. However, the minimum size is likely to remain above 50 000 tCO_2e per year for regular CDM projects.

The simplified methodologies adopted by the Executive Board for small-scale CDM projects may reduce the transaction costs for those projects enough to make such projects economically viable. Small-scale CDM projects are likely to have annual emission reductions of less than 50 000 tCO_2e. At present there is no information on the potential number of small-scale projects nor on the aggregate emission reductions might those projects achieve.

The market rates of the fees charged by the CDM facilitators are as follows:

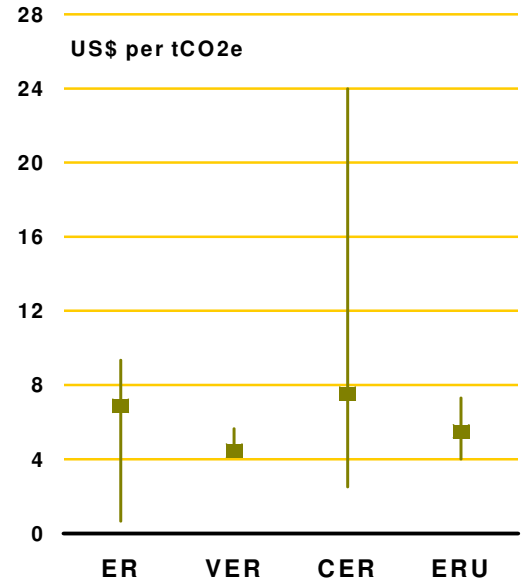
Baseline Study	- US $ 18,000 – 23,000
Monitoring plan	- US $ 7,000 – 15,000
Validation	- US $ 15,000 – 30,000
Legal and contractual agreement	- US $ 23,000 – 38,000
Verification	- US $ 7,000 per audit

Source: UNEP (2003)

2.1.3 Prices of CERs

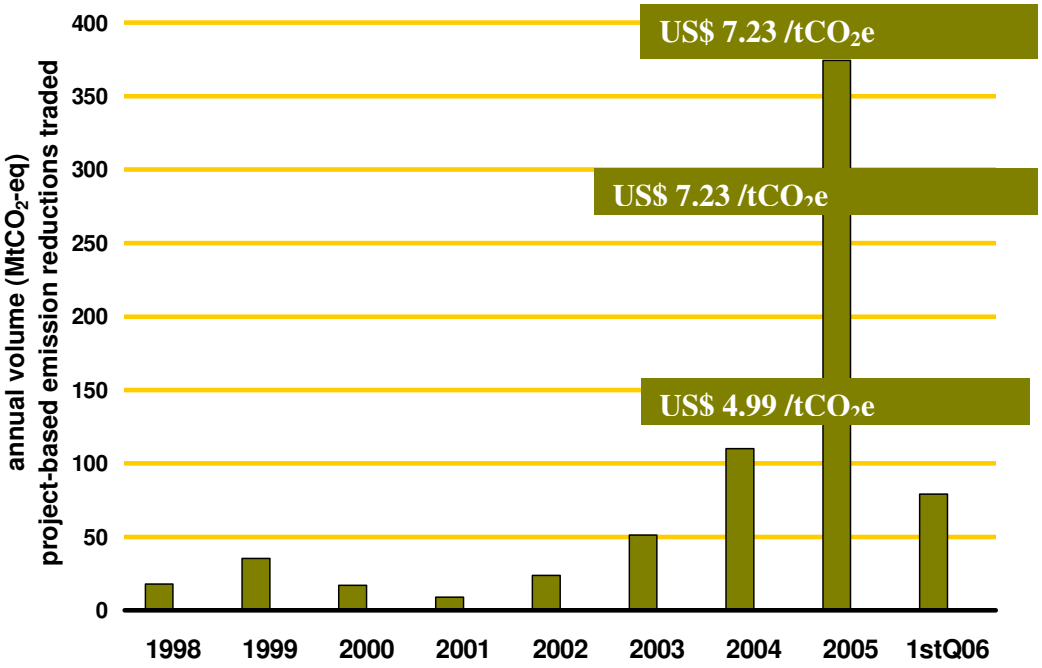
The viability of small scale project therefore depends on the prices of CERs (figure 5 and 6).

Figure 5 - Prices of emissions reductions (Jan 2005 – March 2006)



Source: The World Bank

Figure 6 - Increase of Traded emission reductions and prices



Source: The World Bank

2.1.4 Impacts of CDM on project IRR

The impacts of CERs revenue on the total project investment vary by project types. Table 10 presents the results of sensitivity analysis of the contribution of CERs revenues.

Table 10 - Summary Sensitivity Analysis - Incremental IRR Results – Contribution of Carbon Finance

Sector	Impact (%) Price = $6.5/ton CO_2e				CF Impact (% range)
	Purchase 7y	Purchase 10y	Purchase 14y	Purchase 21y	
Landfill	5.5 – 46.8%	13.9 - 48.8	17.6 - 49.3	20.3 - 49.3	5.5 - 50
CH_4 from coal	7.6	9.7	10.8	11.5	7 - 12
Bio mass	1.9 – 3.5	2.3 – 5.1	2.6 – 6.3	2.9 – 7.1	2 - 8
Forestry	0.4 – 4.6	0.9 – 5.7	1.7 – 6.3	2.6 – 6.8	0.5 - 7
Renewable Energy	0.2 – 1.7	0.3 – 2.2	0.5 – 2.6	0.6 – 2.9	0.2 - 3
District Heating	0.5	0.6	0.6	0.7	0.5 - 1

2.2 Global carbon market potential under the Kyoto Protocol

A review of National Communications submitted by Annex I countries indicates that the total demand for Annex I countries is 846 $MtCO_2eq$ per year, with an uncertainly range of 415 – 1250 $MtCO_2eq$ per year (Grubb et al. 2003). According to this analysis, the supply potential for hot air and joint implementation emission reduction units has been estimated to range from 365 – 1070 $MtCO_2eq$ per year. Based on these results, the global CDM market potential can be estimated to be between 50 $MtCO_2eq$ and 180 $MtCO_2eq$ per year.

According to some analysis, the entire Annex I demand could be met from the Hot air (surplus GHG offsets) from Russia and Eastern European Countries. However, of the total of 127.2 $MtCO_2eq$ transacted in 2004, 82 $MtCO_2eq$ were from CDM, which have been contracted at a weighted average price of 4.2 euros per tCO_2eq.

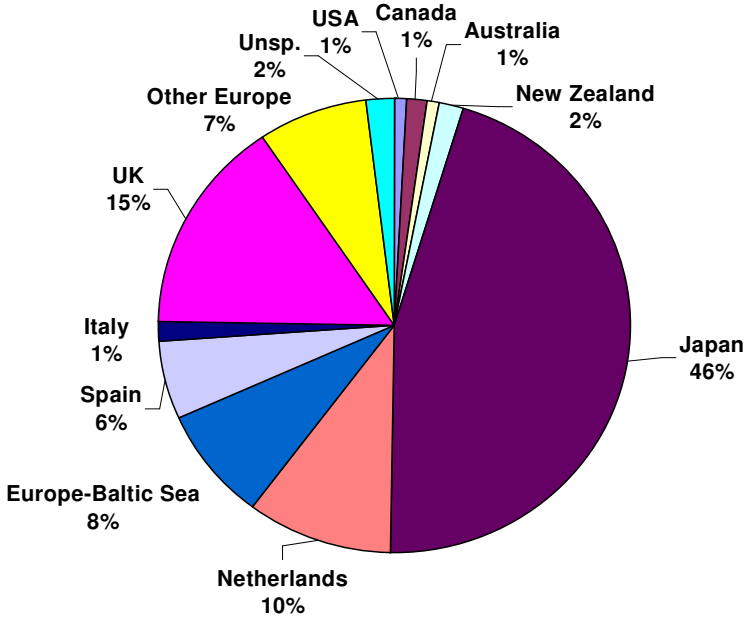
The estimated market potential of the CDM is a demand for CERs in 2010 of 250 $MtC0_2e$ (range 50 to 500 $MtC0_2e$) at a price of$11.00 $/tCO_2e$ (range ± 50%) (IETA 2004). This represents a total demand of 1250 MtC02e by 2012. The minimum demand by industry in Europe and the planned purchases by governments yield an annual demand of at least 100 $MtC0_2e$ for CERs and ERUs. The median demand by industry in Europe combined with estimated government purchases by Annex B governments yields a potential demand for CERs and ERUs of roughly 230 $MtC0_2e$ in 2010.

The market for project-based ERs is still growing steadily: 107 million metric tonnes of carbon dioxide equivalent ($tC0_2e$) have been exchanged through projects in 2004, a 38% increase relative to 2003 (78 $mtC0_2e$). We estimate that the volume exchanged so far in 2005 January to April) is 43 $MtC0_2e$, most of which under either Joint Implementation (JI) or the CDM. In the past 12 months, the number of JI and CDM projects under development has also increased substantially, with notably a large supply of unilateral CDM projects.

2.2.2 CERs buyers

New buyers of emission reduction have emerged. Private and public entities in Europe now represent 60% of the volume of ERs purchased through project-based transactions (Jan. 2004 to April 2005), against 21 % for private and public entities in Japan and 4% for private entities in Canada. The figure 7 illustrates the market share by buyers in 2005.

Figure 7 - Market share by buyers in 2005 (374.3 MtCO2e)



2.2.2 CERs sellers

The geographic distribution of the estimated CDM potential is similar to the distribution of projected energy investment to 2010, projected energy-related C02 emissions in 2010 and projected growth of energy-related CO_2 emissions between 2000 and 2010. But it differs somewhat from the historic patterns of foreign direct investment (FDI) and official development assistance.

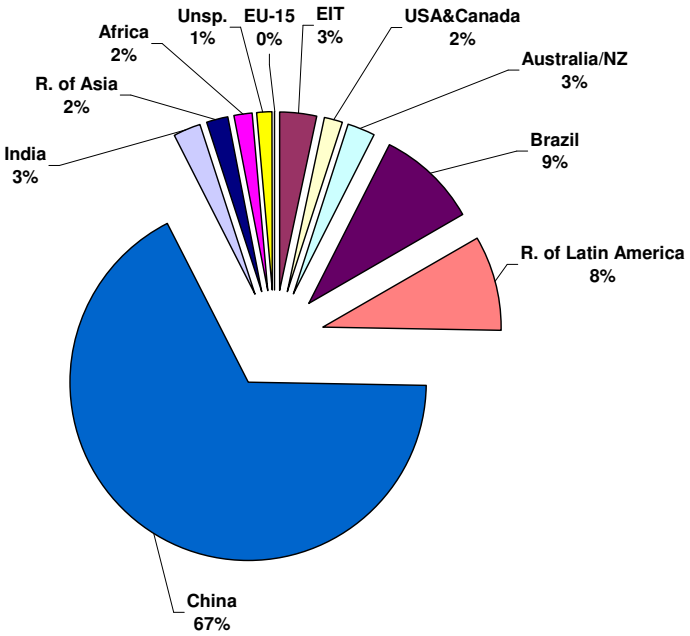
Latin America currently has more CDM project activity relative to its estimated potential than any other region, consistent with the pattern of FDI. Project activity relative to estimated CDM potential is low in all other regions. Due to its large share of the global CDM potential, the scale of CDM activity in Asia, and in particular China, could have a substantial impact on the total supply of CERs (figure 8).

Annual emission reductions in 2010 of 400 $MtC0_2e$ would require an annual investment of about $10 billion. Foreign direct investment (FDI) in developing countries averaged $140 billion per year during 1997-2002 and often varied by more than $10 billion from one year to the next. The projected energy investment required for developing countries between 2001 and 2010 is $192 billion per year.

The supply of emission reductions has remained heavily concentrated in a few countries: notably India-by far the largest supplier of project-based ERs on the market-, Brazil and Chile. Apart from a few small-scale deals, poorer or smaller countries have seen limited activity since January 2004. As at 12 September 2006, the

expected CERs form registered projects during the first commitment period (table 11) is 82 $MtCO_2eq$ (UNFCCC CDM website).

Figure 8 - Market share by seller in 2005



2.2.3 CDM projects registered up to September 2006

Up to September 2006, 306 CDM projects have been registered which are expected to reduce 570 M t/CO_2 e. So far, 15.4 t/CO_2 e CERs have been issued. Table 11 Present distribution of registered CDM projects by countries.

Table 11 -Expected annual CERs from registered projects by host country as at 12/09/2006

Country	Average Annual Reductions t/CO_2 e
Argentina	**1,765,007**
Armenia	**197,832**
Bangladesh	**169,259**

Bhutan	**524**
Bolivia	**82,680**
Brazil	**14,163,224**
Cambodia	**51,620**
Chile	**2,183,123**
China	**36,665,416**
Colombia	**66,180**
Costa Rica	**162,515**
Ecuador	**258,261**
El Salvador	**360,268**
Fiji	**24,928**
Guatemala	**142,245**
Honduras	**205,251**
India	**10,566,516**
Indonesia	**271,938**
Israel	**93,452**
Jamaica	**52,540**
Malaysia	**1,615,972**
Mexico	**4,003,888**
Mongolia	**11,904**
Morocco	**223,313**
Nepal	**93,883**
Nicaragua	**336,723**
Panama	**60,343**
Papua New Guinea	**278,904**
Peru	**199,265**

Philippines	**56,788**
Republic of Korea	**11,075,612**
Republic of Moldova	**47,343**
South Africa	**25,739**
Sri Lanka	**104,130**
Viet Nam	**681,306**

2.2. 4 Sector distribution of CDM projects

HFC_{23} destruction is still the dominant type of emission reduction projects in terms of volumes supplied (25% from January 2004 to April 2005). Projects capturing methane and N_20 from animal waste now rank second (18%), ahead of hydro, biomass energy and landfill gas capture (about 11 % each). Projects abating non-$C0_2$ emissions account for more than half of the total volume supplied, while traditional energy efficiency or fuel switching projects, which were initially expected to represent the bulk of the CDM, account for less than 5% .

Due to the heterogeneity of the underlying projects and contracts terms, the spread of prices of project-based emission reductions at any given time is very large. The whole spread has also moved substantially upward since last year's report. Verified Emission Reductions have traded

Certified Emission Reductions have traded between $3 and $7.15/tCO,e over the same period of time, with a weighted average of $5.63/$tCO_ze$ The decline of the dollar relative to the euro can explain only part of the observed increase relative to last year

The large projects that account for most of the potential CDM supply have a lead time of four or five years. Thus new project ideas initiated now would only yield emission reductions after 2007. This means that emission reductions beyond those from currently identified projects depend heavily on new project ideas initiated now and implemented during 20082012. That could lead to a significant acceleration in the flow of new projects in 2008, which could strain the capacity of the designated operational entities and the Executive Board.

The project types that have an average size sufficiently large to be economically viable account for most of the CDM potential. These project types include: energy efficiency measures in the residential, commercial and institutional sectors; energy efficiency in industry; landfill gas capture and utilization; methane reductions in the oil and gas industry; renewable electricity generation; and afforestation and reforestation. Other project types, such as recovery of coal-bed methane and reduction/destruction of non-

methane GHGs, appear to be economically viable, but do not represent a large share of the total potential.

At present energy efficiency projects are under-represented relative to their estimated potential. This suggests the existence of factors, such as high administrative costs or other barriers that are not fully reflected in analyses of the achievable potential for these projects. On the other hand, renewable electricity generation and projects that involve non-C02 gases, such as methane, are over-represented. The higher global warming potential values of nonC02 projects tend to improve the project economics.

Figures 9 and 10 illustrate the sectoral distribution of CDM projects registered with the CDM executive board. The energy sector has contributed to 50% of the projects.

Figure 9 - Sector distribution of CDM projects

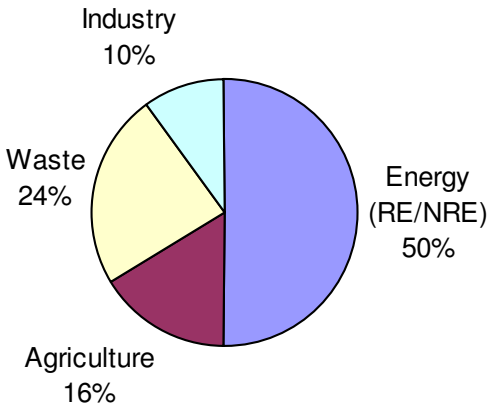
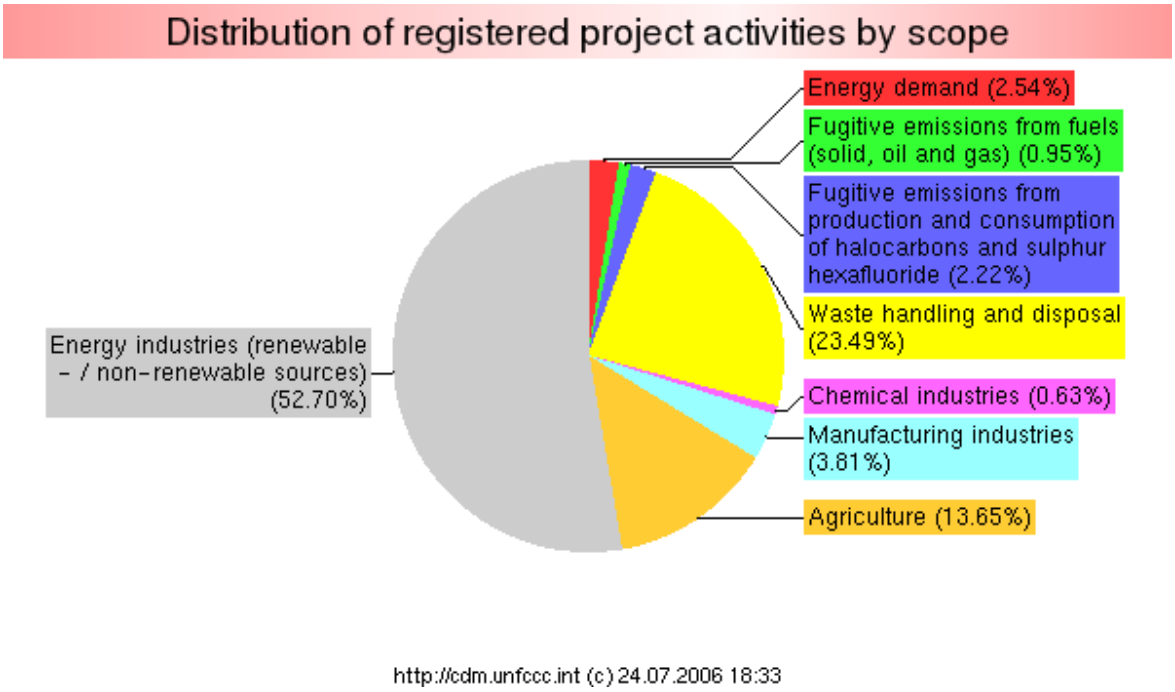


Figure 10 - Sector distribution of registered projects by scope



2.3 Impacts of emissions trading on CDM

Emission Trading (ET), although it is described under a separate Article (Article 17) in the Kyoto Protocol, is closely linked with the Clean Development Mechanism (CDM) and Joint Implementation (JI), the two project-based mechanisms adopted by the Kyoto Protocol to the UNFCCC. Therefore the global potential of Emission Trading is also related to the potential of implementation of CDM and JI, which are the important flexible mechanisms in achieving the common goal of the UNFCCC.

Size of the potential market for the three flexibility mechanisms under the Kyoto Protocol during the first commitment period 2008-2012, both on demand side and supply side has been estimated. Annex 1 countries must reduce GHG emissions about 620.6 MtC in 2010, in order to meet the Kyoto targets. This will take place domestically, through emission trading, JI with other Annex 1 countries, and acquisition of certified CDM credits from non-Annex 1 countries. For countries whose Kyoto targets are higher than the anticipated emissions, even in the absence of any limitation, they will have surplus assigned amounts of 105 MtC available for sale.

Because energy efficiency in countries with economies in transition is very low in comparison to OECD countries, in addition to the supply of hot air, these countries could make 25% of their projected baseline emissions in 2010 available for sale through improving energy efficiency. This will lead to a supply of 348 MtC. Projected baseline emissions of the developing countries will be 4000 MtC in 2010, and CDM credits will

be 800 MtC (Zhang draft report, 1999). By adding the supply from each mechanism, the aggregate potential supply for GHG offsets is estimated to be 1253 MtC, which is substantially larger than the estimated aggregated demand of 620.6 MtC. The price of a carbon ton and total demand and supply will be highly uncertain and difficult estimate.

CHAPTER 3 - ANALYSIS OF THE CURRENT POLICIES, AND THE BARRIERS (LEGAL, FINANCIAL, TECHNICAL AND INSTITUTIONAL) THAT HINDER ITS DEVELOPMENT

- to be improved by Mr.Avanthi Jayatilake –

3.1 Institutions

The institutional and administrative structure of the Democratic Socialist Republic of Sri Lanka is based on its republican constitution. The Executive President of the Republic is elected by the people and holds office for a term of six years. Parliament, which consists of 196 members elected by the people and 29 members from the national lists, also continues for six years. The President appoints the Prime Minister and the Cabinet of Ministers and is the Head of the Cabinet. The country is divided into nine provinces for administrative purposes. Power has been devolved to the provinces and the unit of devolution is the Provincial Council comprising a number of members elected by the voters of each province. A Governor appointed by the President heads the province and a Chief Minister appointed from amongst the elected members heads the Provincial Council. A separate Ministry was created for the subject of Environment in 1990 and the Central Environmental Authority which was established in 1981 was strengthened to effective enforcement of the environment related laws and regulations.

Sri Lankan Environmental Management Policy originates from the country's supreme law that is the Constitution. The 1978 constitution recognizes that the state shall protect, preserve and improve the environment for the benefit of the community (Article 24(14)), as principle of state policy. The constitution also recognizes that it is the duty of every person in Sri Lanka "to protect nature and conserve its riches" (Article 28 (f). The pledge given in the 1978 constitution to safeguard the environment was formally institutionalized with the enactment of the National Environmental Act No. 47 of 1980. This Act established the Central Environmental Authority (CEA) in 1981 as the premier state agency responsible for the "formulation and implementation of policies and strategies for the protection and management of environment in Sri Lanka".

The Constitutional pledge for the management of environment was further strengthened by the Thirteenth Amendment to the Constitution which dealt with the devolution of power and administrative responsibility in a number of areas including environment. The Thirteenth Amendment states that the protection of environment within the province to the extent permitted by or under any law made by parliament is the responsibility of the Provincial Council (Ninth schedule, List 1 section 37). In addition to this, the Thirteenth Amendment to the constitution lists the following areas related to environment as devolved subjects and the Provincial councils' environmental health, establishment and maintenance of herbaria, some functions of land use and land improvement, preservation protection and improvement of stock and prevention of animal diseases, regulation of mines and mineral development, fees under the Fauna and Flora protection ordinance, land development.

Ambiguously, some important environmental subjects are listed under the concurrent list, for which, both provincial and central government had to agree on the implementation of the remaining powers which were held concurrently. Such subjects are soil erosion, social forestry and protection of wild animals and birds, and protection of the environment.

Under the Amendment each provincial council had the authority to enact and implement any statute related to their responsibilities. On the basis of these provisions, the North Western Provincial Council (NWP) passed its own environmental statute and created its own Environmental Authority, the Wayamba Environmental Authority (WEA). Other provincial councils have not so far enacted any such statute.

The NWP environmental statute has also prescribed the projects and undertakings which are required to obtain lEE and EIA. This prescribed list does not include large development projects such as power generation and major irrigation works etc. The event of conflicts between a provincial statute and an Act of Parliament with respect to a subject in the concurrent list, the provincial statute takes precedence within the province. This has led to a situation where large scale projects which are not prescribed by the NWP environmental statute would be exempted from the EIA requirement of the WEA.

Other constitutional provisions available for environmental protection are provisions to obtain writs from the Court of, Appeal against administrative acts or omissions (Article 140). eg. the Environment Foundation Ltd., a NGOs applied for a writ of *certiorari* to quash the decision of the secretary to the Ministry of Forestry and Environment to approve the Upper Kotmale Hydro Power Project (CA No.1023/98). The EFL -Ltd also has requested a writ of *mandamus* and writ of *prohibition* from the Court of Appeal under article 140 of the Constitution to direct authorities to take action to stop disastrous sand mining (CA No. 673/97). Under the Article 126 of the constitution, a citizen sought redress from the Supreme Court for violating his right to life that include a right to an environment suitable to live in and right to breathe air of acceptable quality that supports life (SCFR *569* /98).

3.2 Sustainable development policy

Sri Lanka has been implementing national strategies and plans to achieve sustainable economic growth with equitable distribution of income. These national strategies and frameworks for the protection of the environment were in place to a large extent in Sri Lanka even before the Stockholm Summit in 1972. However, there are serious anomalies in income distribution and more than 20 percent of the population (about 4 million people) lives in absolute poverty. One third of families receive poverty alleviation grants under the government's *Samurdhi* programme. National policy to solve the growing problems of poverty and unemployment compounded by population pressure was to achieve a faster growth rate through diversification of agriculture and development of industry in 1970s. The recent transformation in Sri Lanka from a traditional agricultural based rural economy with a sustainable lifetime to a more diversified and commercialised

economy is an indication of the country's attempt to move away from total dependence on agriculture to solve the growing problems of unemployment and poverty.

After the Rio Summit in 1992 the government of Sri Lanka began to follow a more focussed and completed policy towards sustainable development. Sri Lanka actively participated in the Agenda 21 preparation exercise. Since then, the Agenda 21 is being consulted as a guidance document by all development sectors in the Government system as well as by the private sector and the civil society. The entire government system was alerted to the need for environmental conservation particularly of natural resources and many activities and programs were launched for that purpose. Principles of sustainable development are contained and enshrined in most of the development programs. During the period of 1996-2000 the Government pursued the objectives of accelerating economic growth, while ensuring equity and a higher quality of life particularly for the poor.

During this period, the bias was towards environmental conservation more than economic development. In the second half of the 1990 decade, the government realized the need to strike a balance between environmental conservation and economic development. Principles of sustainable development were highlighted which required the Government to address not only environmental issues but also economic and social issues simultaneously. The triangular relationship between the economy, the society and the environment in the geo-political, biophysical, and socio-economic development process was brought in to strong focus of the government.

3.3 National environmental policy

……To be completed ….
A National Environment Action Plan was developed to provide the policy framework for sustainable development. A participatory approach was followed in preparing this policy. National policies such as forestry, wildlife, coast conservation, several draft national policies yet to be approved by the government such as environment, lands, and long term development plans and strategies such as Forestry Sector Master Plan, National Environment Action plan, Coastal 2000, promote participatory approach in natural resource management. They advocate active public participation and the multiple stakeholder involvement in the planning, implementing, monitoring and evaluation of a development activity with full transparency and accountability on the part of all parties.

The NEAP as a national sustainable development strategy encourages the integrated approach for the management of natural resources and environment. The NEAP is a national action plan and a policy framework on environment which contain many recommendations to integrate environment and development. No single agency can take the responsibility for implementing the entire plan. Government agencies, non-government agencies and private sector are expected to implement it. Therefore, the link between central government institutions, provincial and local authorities, co-management with community organisation and NGOs are clearly recognised.

The NEAP clearly recognizes the role of private sector, role of NGOs and the role of the civil society. While recent legislations such as Fisheries Act and Amendment to the Forest Ordinance emphasize co-management, older laws such as Fauna and Flora Protection Ordinance often limit or prohibit any form of meaningful community participation.

The NEAP also recognizes the importance of public-private partnership for environmental management. Examples for the private-public partnership in the implementation of sustainable development strategies are participatory forestry projects, medicinal plant conservation project and wild life conservation and protected area management project. Co-management of natural resource has also being recognized.

National Planning Department has introduced environment screening of all public sector investment projects. Environment Impact Assessment (EIA) has been made statutory for all prescribed projects and the EIA procedures are being constantly reviewed updated. Sectoral EIA guidelines are being finalized for a number of sectors. Environment Protection Licensing (EPL) Scheme is compulsory for all projects. The EPLs has been decentralized.

3.4 Review of policies related to CDM in Sri Lanka – Power Sector

The long awaited power sector restructuring finally got under way with the incorporation of "Electricity Reform Act No. 28 of 2002" in December 2002.

An extract of a policy statement issued by the Government soon after the incorporation of the above act reads as follows (Ref.13):

The overall energy development goal of Sri Lanka is to meet the demand for energy services with affordable, reliable, diverse, safe and environmentally sustainable choices of people of Sri Lanka in economically and socially most efficient manner. Within this board framework, the rationale behind the reform objectives in relation to electricity is that, given proper institutional frameworks, pricing signals and regulatory regimes, markets can efficiently deliver on the economic development objectives, including adequate, high quality and reliable services.

Accordingly, the economic and social objectives after restructuring the electricity sector in Sri Lanka are as follows:

- Increasing competition in the electricity industry to bring about more efficiency within the industry, while ensuring the provision of adequate and best possible electricity supply and services, reasonable price levels and safety standards to electricity users.
- Attracting foreign investment and mobilizing local private capital and expertise for the sector; This objective focuses on promoting investments for widening access to encouraging efficiency, increasing generation capacity including

expanding the use of advanced, clean fuel technologies, and accelerating new renewable energy diffusion.

- Reducing the investment burden on the government as well as the public sector debt; with the increased private investment following to the power sector, the public funds utilized for the development of power sector will be allocated on the basic of economic and social opportunity cost.
- Promoting the more efficient use of electricity such as that demonstrated by Lanka Electricity Company Limited.
- Creating a more competitive and efficient market for the human resources in the electricity sector.
- Widening access globally competitive technology in the sector.
- Encourage general public participation in the electricity industry development in the country through the development of the capital market.
- Developing the capital market.

The following policy premises supplement these objectives:

- Since the electricity supply industry in Sri Lanka is currently a state monopoly, the increase in the role of the private sector in the industry must be to promote competition and avoid transfer of the public monopoly to a private sector monopoly.
- Markets alone cannot be expected to meet the needs of the most vulnerable electricity consumers and to protect the environment. Where markets appear to fail to protect these and other important public benefits, targeted policies such as rural electrification and consistent regulatory approaches such as tax concessions, life line tariffs and measures to ensuring an adequate supply will be given due consideration by the government.

The economic and social objectives of restructuring the electricity sector will be in conformity with the following overall energy sector development objectives:

- Providing basic human energy needs.
- Reducing dependence on imported energy.
- Diversifying energy sources.
- Choosing the optimum max of energy sources taking into consideration the ability to influence demand on source types.
- Optimisation of the operation on indigenous energy resources (hydro electricity, bio-mass, wind, solar etc.).
- Conserving and eliminating wasteful consumption in the production, distribution and use of electricity.
- Ensuring continuity of energy supply.
- Increasing the content of local manufacture, fabrication, construction and value addition in the energy supply and utilization areas.
- Establishing the capability to develop and manage the electricity sector.

3.4.1 Policy on rural off-farm employment and electrification

The policy on Rural Employment and Electrification has been spelt out in the "Regaining Sri Lanka" as described below (Ref. 14).

Agriculture alone will not be sufficient to raise incomes in the rural areas. There is compelling evidence that those rural families that derive the greatest share of their income from off-farm income are able to work their way out of poverty the fastest. Access to electricity is necessary for practically any off-farm activity. Without access to electricity, rural areas cannot host the industries and other off-farm income-generating activities that are essential to a pro-poor process of structural change. Electric lighting, unto itself, also makes a very important contribution to the quality and effectiveness of rural education.

There are vast differences in regional access to electrification. In the Western Province, where the incidence of poverty is relatively low, nearly 80 percent of the households have access to electricity. By contrast, less than 20 percent of the households in the North-Central Province have access to electricity. In the Sabaragamuwa, Uva, North Western and Central Provinces, between 40 and 50 percent of the households are without access to electricity. But progress is being made on bringing electricity to under serviced areas. Between 1980 and 1998, the total number of village electrification schemes increased from 2,115 to 14,690. These now cover some 53 percent of all villages in the country. By 2005, the Government aims to bring electrification to some 80 percent of the nation's villages. Some 600 rural electrification schemes, covering eight provinces will provide electricity supply to about 112,500 additional households and other consumers. This will be an increase of about 5 percent in the nation's total connections (by 2005). Some 600km of 33-kv development lines will be supplied to strengthen CEBs existing distribution networks in rural areas, which are becoming overloaded, and to reduce losses on those lines. A range of alternative energy sources (solar, wind, mini-hydro) will also be developed through community-based organizations and the private sector to expand rural electricity access, particularly in the more remote, dry zone regions. Where capital costs for rural electrification are prohibitive, transparent subsidies will be provided, to expand access.

3.4.2 Barriers for Renewable Energy

According to the "Long Term Generation Expansion Plan: 2003-2017" prepared by the Ceylon Electricity Board (CEB), Sri Lanka's electricity requirement has been growing at an average rate of 7-8% annually. This trend is expected to continue in the foreseeable future. To meet this demand about 200 MW of power plants need to be added to the national grid. Until 1996, electricity demand was met by CEB owned hydro and thermal generating plants. Since 1996, private sector has also participated in power generation. The existing generating system in the country is still predominately (76%) owned by CEB. The balance (24%) is owned by Independent Power Producers (IPP).

The country for a variety of reasons is experiencing difficulties in meeting the growing demand for electricity from conventional fossil fuel sources. The Government policy is to harness the maximum viable potential of alternative energy sources to supplement the conventional sources.

The following barriers are encountered by the renewable energy sector. A few of these barriers are relevant for specific types of renewable energy:

- **Buy-Back Tariff:** The Buy-back tariff offered by the CEB for small renewable energy is about half of the tariff offered for fossil fuel based electricity generation. The reason given for this difference is the inability of small renewable energy sources to contribute towards the capacity component of the electricity system. While this may be true for certain types of renewable energy such as wind and small hydro projects, this is not true for biomass based projects. More over, from a practical point of view, all small renewable energy projects do contribute towards capacity requirements of the system. As renewable energy sources have many advantages such as energy security, it is prudent to overlook any shortcoming in renewable energy and grant a tariff comparable to fossil fuel based systems. This should be included as a policy statement of the Government.

- **Lack of Project Funds:** For major fossil fuel based projects, funds are made available by donor agencies on concessionary terms. During evaluation these features make these fossil fuel based projects deliver energy at comparatively lower costs. For small renewable energy projects, funds need to be obtained from private sources or from banks at commercial rates. This makes the renewable energy projects more expensive.

- **Grid-Absorption Capacity:** The national electricity demand for energy is growing at around 8% per annum. This means that at the present level the generating capacity of the system should be increased by around 200 MW annually. To generate and distribute this additional capability, the transmission and distribution network along with substation capacities should be adequately increased. This may be carried out by connecting renewable energy generators to an existing distribution network. Currently, CEB has indicated their inability to absorb such power plants.

- **Approvals from Statutory Authorities:** Obtaining approvals from various statutory authorities for the establishment of power plants is a very tedious task.

- **Biomass Power Plants:** Biomass power plants require adequate supply of biomass fuels. Although the government has declared energy plantations as a National Plantation Crop, this has not been adequately implemented. In order for private sector institutions to invest in biomass power plants, adequate energy plantations should be in place. This task should be undertaken by the government.

- **Lack of Renewable Energy Policy:** Renewable energy has many economic benefits. Hence, the government should formulate a renewable energy policy and implement it. The CEB should be directed to incorporate such policy into their generation plan.

- **Hydropower:** Most projects are smaller than the minimum capacity for eligibility/feasibility for CDM. Bundling of projects is difficult when not owned by the same company/organization. However, organizations such as the Grid Connected Small Power Developers Association could help with forwarding the bundled CDM applications on behalf of the project developers.

- **Alternative Energy:** Solar power projects in Sri Lanka have CDM potential if bundled. Mechanisms for such applications and the required facilitation systems and expertise are not in place. These projects have a favourable community component for CDM.

- **Energy Conservation and Energy Substitution**: Projects under this category do not contradict the policies of the CEB or other state institutions, hence, would be easier to implement. However, the major barrier encountered in implementing these projects is the high interest rates prevailing for funds from commercial banks. From the CDM project incorporation point of view, bundling some of the smaller projects poses a practical problem.

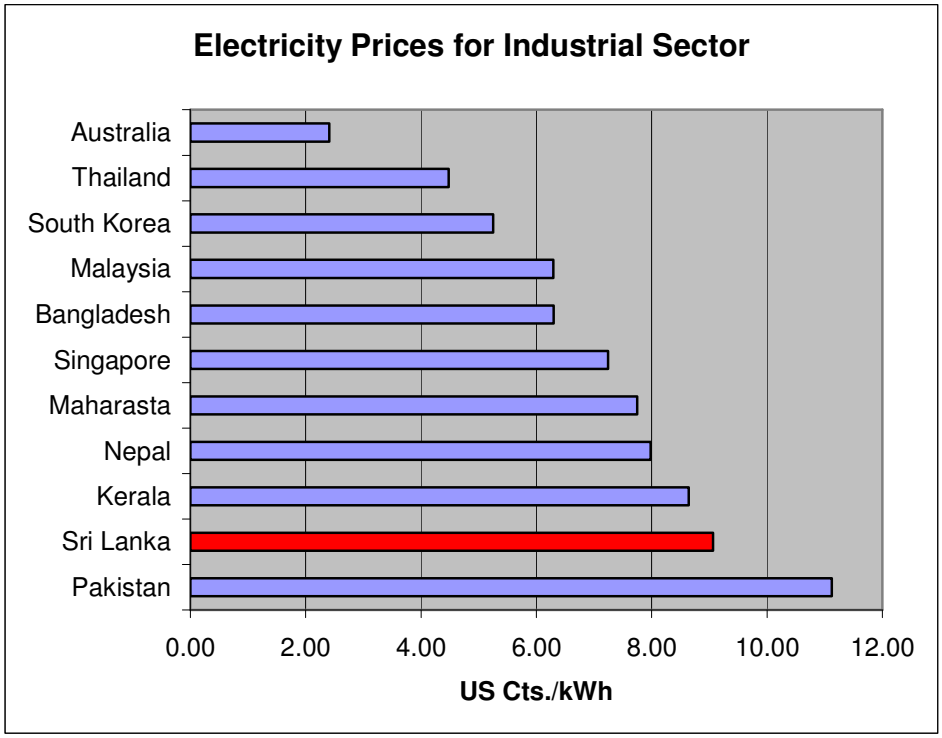
3.5 Barriers to biomass power generation

Interest in biomass energy for electricity generation has risen in the recent past. However, there are a number of constraints preventing the development of biomass based electricity generation. Some of these constraints and issues are discussed below:

(a) Lack of realistic planning

Although the electricity sector regularly carries out elaborate planning about future generation needs, these plans are not implemented as expected for a variety of reasons. Short and medium term proposals outside the long-term generation plans are regularly introduced to meet the shortfall in generation needs. These proposals are outside the "optimum" energy mix envisaged in the long-term plans. Hence, the implementation of these plans has resulted in the cost of electricity well above the anticipated and accepted values. The average sale price of electricity in Sri Lanka and the corresponding values for selected countries are illustrated in Figure 11.

Figure 11 -Industrial electricity prices in selected countries (Ref.4)



Apart from the high cost of electricity, the delays in implementing generation projects have resulted in load shedding. Table 3 below gives the hours of national forced interruptions in the corresponding years. These power interruptions have resulted in severe adverse impact on the national economy.

(b) Failure to implement Government policies

Although successive governments have emphasized the importance of an integrated approach in the implementation of energy projects (CEB 2003) incorporating all relevant social and economic benefits such as local employment, conservation of foreign exchange, energy security etc., the share of renewable energy (apart from large hydro) has been insignificant in the energy mix of the electricity sector. The Government machinery is under pressure to deviate temporarily from laid down objectives. The electricity sector's decisions are focused on commercial viability. At times, Government's long-term policies are not given adequate weight age.

(c) "Un-level" playing field

All over the world, including the developing countries, renewable energy projects receive some form of government subsidy at least in the initial phase of development. Surprisingly, in Sri Lanka, fossil fuel based sector receives many benefits. Some of them are given below.

The price for electricity generated by Independent Power Producers (IPP) for fossil fuel based and renewable energy based Small Power Producers (SPP) sectors for the year 2002 are given in Table 12.

Table 12 - Tariff for fossil fuel and small renewable energy IPPs 2002

Name of Power Plant & Fuel	Tariff (SLR/kWh)
Hired Power – Auto Diesel	11.01
Kool Air-KKS – Furnace Oil	8.60
Asia Power – Furnace Oil	8.12
Lakdhanavi – Furnace Oil	7.41
Barge Mounted – Furnace Oil	7.06
ACE-Matara – Furnace Oil	6.72
ACE-Horana – Furnace Oil	6.13
Average (Private + Hired)	8.69
Private Small Renewable (SPP)	4.97

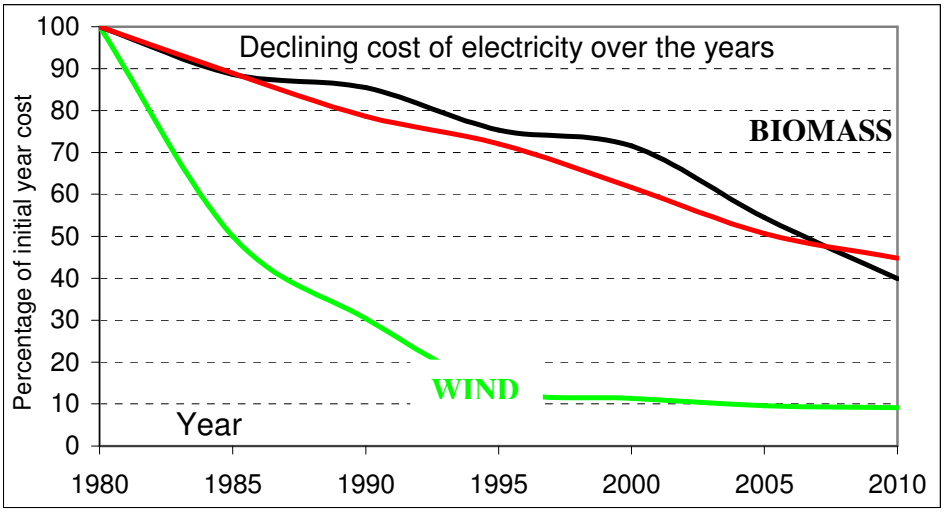
It is also important to note that the tariff for (small, renewable energy) SPP is determined by the "Avoided Cost" method, while the prices for the fossil fuel based IPP are determined on negotiated formulae.

(d) Failure to appreciate the long-term benefits of renewable energy

Energy planners in Sri Lanka do not accept the "learning curve" effect of new technologies in respect of renewable energy projects. It is a well-known fact that new renewable energy technologies such as wind, biomass, photovoltaic etc. encounter high initial costs in the early phase of development. Over the years, refinements are made to the systems and the costs gradually decrease. About a decade ago, when wind generators were introduced in Europe and in America, the cost of a unit of electricity was 38 US Cts. per kWh. Today in Europe, electricity from wind power plants is produced at less than 4 US Cts. per kWh. New offshore wind power plants are expected to produce electricity even cheaper. Figure 12 illustrates the declining trends of energy prices from renewable technologies.

In Sri Lanka, it is imagined that large coal based electricity could be generated at less than 4 US Cts. per kWh. The utility is reluctant to accept renewable energy projects with cost of generation over this price.

Figure 12 - Declining costs of renewable energy technologies (Ref: 6)



(e) Failure to appreciate the benefits of decentralized energy

The long-term generation expansion plan prepared by the utility in Sri Lanka is based on the lowest generation cost of electricity. It is taken for granted that if energy is generated cheaply, it could be sold cheaply. The costs of transmission and distribution are assumed to be constant irrespective of the location of generation and the location energy consumption. The reduction in the transmission and distribution costs by locating power plants closer to load consumers is not evaluated.

Moreover, no attempts are made to promote co-generation or absorption refrigeration from waste heat.

(f) Lack of a state institution to facilitate biomass energy development

Despite the fact that 53% of the national primary energy and 72% of the energy needs of the industrial sector are met from biomass (Ref. 7), this energy source is classified as a "Non-Commercial" energy. No state institution is assigned to facilitate the development of this source of energy. In 1997, the committee appointed to formulate the Energy Policy for Sri Lanka (headed by Prof. K.K.Y.W.Perera) made a strong recommendation for the creation of a Biomass Energy Agency (Ref.8). To date this has been ignored.

A group of dedicated individuals have formed a private association (Bio Energy Association of Sri Lanka – BEASL). The Government is considering some of the requests made by this association favourably. The most important request for an equitable tariff for small power producers is yet to be addressed by the Government.

(g) Access to land for energy plantations

Many private sector institutions have come forwarded to establish energy plantations and biomass power plants with capacities ranging from 1 to 10 MW. However, they are unable to obtain information on the availability of suitable land for the establishment of energy plantations. The Land Use Policy Planning Division (LUPPD) of the Ministry of Lands has revealed to the Ministry of Science and Technology the availability of some 1.6 million hectares of degraded marginal land suitable for energy plantations. LUPPD is compiling data on all such land. This information should be made available to the public domain. Any one interested in land should be able to make use of this information and obtain such land according to stipulated procedures.

(h) Funds for bio energy

Initial capital costs and recurring operational costs including fuel costs of biomass power plants are comparable to the corresponding costs of large coal based power plants. However, the break-even price for a unit of energy from biomass power is US Cts 7 per kWh. Whereas for coal power there seems to be offers at a unit price of US Cts.4. The reason for this discrepancy is that for biomass projects developers can obtain funds locally at an interest of 9% and repayable with in 7 years. For coal power, international funds are available at around 1 to 2% and payable in 25 to 30 years. This barrier must be removed.

The proposed Bio Energy Agency should make arrangements to provide this service.

(i) Skepticism on the potential of bio energy in Sri Lanka

A vast majority of decision makers do not take note of the fact that 72% of the energy for the *industrial* sector comes from bio energy (Ref.7). Perhaps, Sri Lanka is the highest in the world in this respect. Large-scale development of bio resources for modern energy needs was first mooted in Sri Lanka in 1980. It took about a decade to convince a few key people in the country of this potential. Even after more than 20 years, only a handful of officials are convinced of this potential.

(j) Requirement of diverse resources

Two distinctively divers resources are needed to establish and operate a bio energy system. The skills and resources required for plantations are different to those required for power plant. It is difficult for an entity to possess these diverse skills and resources. We need to bring two such entities together. For the plantations we need skills in labour management, and agronomy. For power plant we need engineering skills.

(k) Plantation or power plant: which should come first?

If two independent entities were to establish these two components, the question arises, “which should come first?” If plantations come up first and if there is a delay or a failure

in the establishment of power plants, how could the expenditure on plantations be recovered? Similarly, if power plants are erected and the plantations are not ready, how could they operate the power plant?

In terms of cost, the plantation for a 1 MW power plant would cost SLR 10 million (USD 100,000). The power plant itself would cost SLR 80 million (USD 800,000). Plantation to power station costs is in the ratio of 1:10. Moreover, an energy plantation has other uses. Presently the industrial sector in Sri Lanka annually consumes 264,000 tonne oil equivalent of petroleum fuels valued at USD 50 million to produce process heat (Ref.7). This could be replaced with 0.8 million tonnes of wood from 27,000 hectares of energy plantations.

Therefore, it is the duty of the Government to provide necessary incentives to promote the establishment of plantations.

(l) Price stability

The Small Power Purchase (SPP) tariff provides a safety net of 90% of the initial price as a minimum price for the energy generated in succeeding years. This should be increased to 100% for the first 25 MW of biomass power for the first 7 years of operation to create investor confidence. It could be examined after this period.

As energy plantations and power plants may not be owned and managed by the same entities, the price of fuelwood applicable for the sale of fuelwood by the plantations to the power plants also should be controlled.

This situation is very similar to the sale of green tea leaves by tea small holders to "bought leave factories". In this instance, the Tea Smallholder Authority has formulated a formula based on the sale price of made tea. This system has been functioning satisfactorily.

A more complicated situation prevails in the coconut sector. Coconut is used for many different applications such as copra manufacture, desiccated coconut, food nuts etc. The profitability in each of these applications varies. As the production of coconuts is limited and varies seasonally, coconut price also varies seasonally. Desiccated coconut is an export product. The international market decides its price. During some seasons, the cost of production of desiccated coconut exceeds far above the market price due to the very high price of coconuts. During such times, production of desiccated coconut is curtailed or halted.

Such a situation might arise for biomass power generation during rice harvesting season, due to temporary shortage of labour. Each biomass power plant should maintain adequate stocks of fuelwood to cater to such eventuality. Fortunately, fuelwood, unlike coconuts, does not perish easily.

(m) Unavailability of national grid for export of electricity

The profitability of a power plant is very sensitive to the annual plant factor. Some of the embedded generators in Sri Lanka have experienced poor annual plant factors due to breakdown in the Medium Voltage (MV) line connected to the generator. During such a down time, the generators need to be shut down as the power generated cannot be exported. Reliability of the MV lines in many parts of the country needs to be improved to acceptable level for biomass projects to be successful. In the alternative, CEB could compensate the IPPs suitably, in a manner similar to the telecommunication network.

(n) Limitations on the total embedded generation capacity

The "CEB Guide for Grid Interconnection of Embedded Generators, Sri Lanka, December 2000, Part 1: Application, Evaluation and Interconnection Procedure" (Ref.9), has raised the following issues in respect of the total embedded generation capacity:

The requirement for some central control of embedded generation capacity will be reviewed when the total embedded generation capacity exceeds 10% of the total minimum grid load. At this time there will be some experience of the effects of embedded generation on grid stability, security and management.

It is expected that there will be a significant increase in the amount of embedded generation capacity, which will make a useful contribution to the CEB grid. It is expected that the contribution of embedded generation will exceed 15% of the minimum demand on the CEB grid by 2020.

It is anticipated that embedded generation will eventually contribute in excess of 15% of the CEB grid capacity.

The requirement for some central control of embedded generation capacity will be reviewed when the total embedded generation capacity exceeds 10% of the total minimum grid load. At this time there will be some experience of the effects of embedded generation on grid stability, security and management.

By year 2020, a reasonable estimate would be a total of 300 MW of Embedded Generators in the CEB system. The total capacity of embedded generation is expected to be less than 6% of the peak load, and about 15% of the minimum load.

In this respect, it is useful to take note of similar concerns raised on this matter in other parts of the world. In Denmark, wind based electricity generation has taken a substantial part of their total system load. At present it is around 10% and is expected to reach 20% very soon. This value is expected to exceed 50% before 2030 (Ref.10).

Wind generators deploy induction generators. They absorb reactive power from the system. The power outputs from wind generators fluctuate very much. Due to low rotational speed wind generators also have low inertia constant. Whereas, biomass

generators are fuel based systems. Apart from forced outages, the outputs of these systems are steady. Due to high speed of rotation of steam turbines, these systems have high inertia constants. Hence the impact of biomass generators on system stability would be minimal.

Distributed generators improve voltage stability and reactive power control to the systems. These are positive aspects of the biomass based distributed generation.

(o) Lack of target for alternative energy

Although the Government has laid a policy to " fully utilize" alternative energy sources to meet our growing needs of electrical energy (Ref.12), the Long Term Generation Plans drawn up year after year do not specify any targets for the share of these sources in the total energy mix. Such a target would drive the developers, planners and Government officials to this goal.

(p) Duty free diesel for IPPs and CEB

In order to keep the average cost of electricity low, the Government is granting duty free concessions to all IPPs and the CEB in respect of diesel fuel used in the generation of electricity. This has created a severe distortion in the market forces in the energy sector.

(q) Biomass based electricity is a new concept

Being a new concept of electricity generation, convincing the authorities to accept this method of electricity generation had been a difficult task. Although this concept was first introduced in 1980 (over 24 years ago), still many officials in the energy sector are sceptical of this concept.

(r) Requires multi discipline

The generation of electricity utilizing biomass obtained from a sustainable energy plantation requires expertise in the fields of agriculture and engineering. These two disciplines are very diverse in nature. Therefore the implementation of a biomass electricity generation project would require the integration of two separate institutions in the above two fields. Identifying two such institutions that are willing to collaborate on a project of this nature had been a difficult task.

(s) Competition with other crops

Paddy is the main crop in the project area. Paddy cultivation has been the main attraction for farmers in the area for many reasons such as long history, main national staple food, facilities made available by the state etc. Price of fuelwood and profitability would be the driving force for the success of Gliricidia cultivation. As cultivation of Gliricidia gives a high return on labour there is good likelihood for farmers in the area to undertake Gliricidia cultivation during paddy non-cultivating seasons.

(t) Awareness on SRC energy plantations

Although Gliricidia has been cultivated in Sri Lanka for many years in Sri Lanka, its application for sustainable SRC energy plantations is a new concept. To obtain optimum results, great care is necessary in the establishment, maintenance and harvesting activities. This could be achieved only through a proper awareness programme.

(u) Fluctuation in annual yields

An average annual yield of 30 tonnes per ha per year has been reached taking into account the yield trials obtained over many years in different locations in the dry zone.(Ref.11). However, the actual yield in any particular interval depends on the rainfall and its uniformity in that interval. Prolonged drought would drastically affect the yield. These features should be taken note of and adequate steps taken to cater to such eventuality.

(v) Rapport with out growers

Supply of fuelwood for the power plant is to be obtained from two sources. (i) From the nucleus plantations entirely managed by the power development company and (ii) from out grower system, partly supported by the power developer and operated and managed by the farmer families within the project area. As the nucleus plantations are expected to be used only in an emergency, it is vital to ensure continuous supply from the out grower system. All attempts should be made to encourage the farmers engaged in the out grower system to main uninterrupted supply as far as possible.

3.6 Institutional Barriers

a) Lack of awareness among government institutions and officials to make use of the benefits of Policy CDM such as energy saving policies, alternate energy policies, waste disposal policies (which incorporates methane abatement etc).

b) Lack of awareness about CDM among policy makers and project developers. Many senior government and private sector officials, who influence decision making activities in the government sector that affect the economic well being of the country, have little knowledge of Global Warming, Climate Change, the Kyoto Protocol, Clean Development Mechanism etc. This has unfortunately created the space for a few interested parties to plant wrong and biased information on CDM among a few officials.

c) Lack of attractive financing for renewable energy projects in the private sector. All large scale energy generation projects are funded by donor agencies. These projects are evaluated under the soft terms offered by such donors. However, all small projects are funded with private funds or funds from banks at commercial rates. This discrepancy gives an apparent advantage to large scale projects. If funds are made available for small renewable energy projects at the same terms as provided for major projects, some of the small projects could be more cost effective and feasible.

d) Renewable energy policy is not finalized. Although many attempts were made to formulate a renewable energy policy, such policies formulated by different committees have not been accepted by the Government.

e) Ceylon Electricity Board's (CEB) failure to include renewable energy projects in the generation plan. The Inter-Ministerial Working Committee on Dendro Thermal Power has formulated an action plan to implement biomass based electricity generation for the period 2006 to 2012. This has been approved by the cabinet of ministers. However, CEB has not include these in their generation plan.

f) Non-coherence and integration of policies in the work plans among different government institutions. For example Gliricidia based energy plantations have been declared as the 4th national plantation crop by the Ministry of Plantation Industries. Wood from these plantations could be used for large scale energy generation. However, CEB does not recognize this opportunity in their generation plan. Foliage from these plantations could be used as cattle fodder in the dairy industry. The Ministry of Agriculture has failed to incorporate this benefit in their dairy expansion program.

g) Banks still not fully geared to offer collateral recognising the income generating potential through CDM. Banks are reluctant to finance CDM projects as they are not sufficiently aware of the risks involved in the process.

3.7 Legislation and regulations related CDM

3.7.1 Legislation on industries

Guideline for the establishment of high and medium polluting industries are in place. High polluting industries should be located only in industrial zone. A programme to introduce cleaner technologies to local industries was commenced in 1994 and continued to date. A National Industrial Pollution Management Policy was adopted in 1996, and a National Strategy for Solid Waste Management launched in 2000. Regulations for hazardous waste management were gazetted on 23rd of May 1996, as an amendment to the gazette notice on Environmental Protection Licensing Scheme (EPL) published in 1990. The Guidelines for the implementation of hazardous waste management regulations were published in 1999**,** and a Solid Waste Management Strategy was adopted in 2000. A major programme was undertaken to improve the Colombo Metropolitan Environment including rehabilitation of canals and lakes in the metropolitan area, reclaiming low-lying areas and demolishing of unauthorised structures. Work on the building of sustainable townships was undertaken to resettle people living in unauthorised dwellings within the city.

3.7 2 Legislation on energy

The power supply being the engine of growth in all other sectors of the economy, any adverse policy in the power sector will have its impact manifested in all other sectors of the economy.

The implicit national energy policy mainly discusses, the providing the basic energy needs for Sri Lanka, choosing the optimum mix of energy resources to meet the energy requirements at the minimum cost to the national economy, optimisation of available energy resources to promote socio-economic development for the country, conserving energy resources and elimination of wasteful consumption in the production and use of energy, developing and managing forest and non-forest wood fuel resources, reducing dependence on foreign energy resources and diversifying the sources of energy imports, adopting a price policy which enables the financing of energy sector development, ensuring continuity of energy supply and energy price stability, and establishing the manpower capability to develop and manage the energy sector.

There can have various policy implications when it is implementing the energy policy. Those implications can be summarized as adoption of the least economic cost approach in the power
sector expansion, elimination of outside interference in decision making in the power sector, integration of environmental implications of power projects at the planning stage of the power project, the development of a rational approach in decision making on vital

development projects such as power projects with regard to the environmental clearance. Environmental clearance is needed to be taken for any energy developing project under the National Environmental Act. Today most of the electricity projects find it difficult to implement those projects under the NEA until it fulfil the parameters of the environmental components.

Emissions standards for power plants have been drafted by the CEA and awaiting public comments.

3.7.3 Legislation on mines and minerals

Minerals play a significant place in the country's economy. At the same time mining operations contribute to adverse impacts on the environment, that include extensive soil erosion, health hazards, disturbing the fauna and flora and damaging natural vegetation. Air pollution, noise pollution, landslides, erosion of river beds and coastlines are also common. The statute pertaining to mines and mineral includes Mines and Minerals Act No. 4 of 1972, state Gem Corporation Act No 13 of 1971 and Radioactive minerals Act No. 46 of 1968 and the Salt Ordinance 46 of 1890.

The Mines and Minerals Act No. 33 of 1992 made number of major changes to the earlier Act. This Act repealed the Mines and Mineral Act No. 4 of 1973 the Salt Ordinance and the Radioactive Minerals Act. This Act also established the Geological Surveys and Mines Bureau in place of the Dept. of the Geological Survey.

Section 29 imposes restrictions on issuing licenses to explore for mines, transport, processing, tendering or export to under-aged or to an applicant who does not possess necessary technical know-how. Section 30 restrict issuing licenses if the location of mining is to be in close proximity to lakes, streams or tank bund, wildlife reservations, nature reserves, forests or parks, catchments areas, foreshore and seabed. Section 35 of the Act provides provisions to check the environmental degradation resulting from the industry of mining. This Act recognizes the sustainable development having included a mandatory provision that the licensee is required to rehabilitate the land upon completion of exploration or mining.

This Act makes references to the NEA No. 47 of 1980 and requires the licensee to adhere to the standards and procedures prescribed under the said Act when carrying out activities under this Act (section 6 1(1).

The drawback of the Act is the non-introduction of 'Environmental Impact Assessment' procedure before issuing mining license.

3.7. 4 Legislation on solid waste

Waste can be classified as solid waste, liquid waste which includes Hazardous and non 1-Iazardous waste. Waste Management is a major environmental problems in Sri Lanka. Hazardous waste has become an important environmental and health issue and concern in Sri Lanka as in many countries including the developing nations. There is ample evidence that the improper disposal of hazardous waste can cause serious damages to health and environment.

Solid waste is described as non liquid waste material arising from domestic, trade, commercial, industrial and agricultural activities as well as waste arising from public sectors, soiled waste comprises of various different materials such as food waste and packaging in the form of paper, metals, plastic or glass, etc. Solid waste is a growing problem in Sri Lanka aggravated in the absence of a proper management system. Development and implementation of National Strategy for solid waste Management is essential to reduce environmental, social and economic problems associated with the present disposal practice.

Recent analysis of date pertinent to solid waste reveals that the real problem associated with solid waste at present lies to a great extent wit Ii present haphazard disposal practices more than with the rate of generation. However rate of generation of solid waste is also increasing with the increase of population technological development and the changes of life styles of the people. Waste management incorporates management activities associated with generation collection transfer and transport, processing and disposal of waste iii an environmentally sound manner. It encompasses planning, organization administration, financial legal and engineering aspects involving interdisciplinary relationships.

The national waste management strategy should be involved with waste avoidance, reduction, reuse, recycling and final disposal in an environmentally sound manner.

Legal framework required for solid waste management is adequately provide under Local Government Acts, and the Local Authorities arc responsible for the collection and disposal of solid waste in the country. The section 129, 130 and 13 1 of the Municipal Council Ordinance: and sections 93 and 94 of the Pradeshiya Sabha Act have clearly and adequately provided for the management and disposal of solid waste in the respective areas.

The provisions relating to Solid Waste Management in Pradeshiya Sabbas Act. Urban Council Ordinance and Municipal Council Ordinance arc as follows:

(a) All street refuse, house refuse, night—soil, or other similar matter collected by Local Authorities under the provisions of this part shall be the property of the Council, and the Council shall have lull power to sell or dispose of all such matter.

(b) Every Pradeshiya Sabbha, Urban Council and Municipal Council shall, from time to time provided place convenient for the proper disposal of all street refuse, house refuse, night-soil and similar mater revived in accordance with the provisions of the Law, and for keeping all vehicles, animals, instruments, and other things required for that the purpose and shall take all such measures and precautions as may be necessary to ensure that no such refuse, night—night soil, or similar matter removed in accordance with the provisions of the law is disposed of in such a way as to cause a nuisance.

* Provisions under National Environmental Act (NEA)

Under Section 1 2 of NEA, the Central Environmental Authority may with the concurrence of the Minister from time to time, give to any local authority in writing such directions whether special or general to do or cause to be done any act or thing which the Authority dines necessary for safeguarding and protecting the environment within the local limits of such authority.

Every local authority to which a direction has been given under subsection (1) shall comply with such directions.

The regulations concerning industrial wastes have been published in Gazette Extraordinary No. 924/13 of' May 23, I 996. This came as an amendment to the National Environmental (Protection and Quality) Regulation No. I of 1990, published in Gazette Extraordinary No. 595/16 of' February 2, 1990. However, these regulations have hardly been enforced.

In the Environmental Bill, Schedule one of Part 11 lists out 19 constituents and 9 waste streams indication what should be considered hazardous waste. Procedure for obtaining license is also set out in this Bill.

Import and Export Act No. I of I 969 has introduced a Special Import License (SIL) scheme relating to Security, environment and Public morals, those who intend to import any item under SI L require to apply to the Controller for a license. The Controller would then impose various conditions as appropriate.

Eg: Obtaining a certificate from Registrar of pesticides before exercising his/her discretion in favour of the importer.

The schedule B of Customs Ordinance enumerates *a* table of prohibitions and restrictions for import and export. Sections 12(1), 43 and 44 of the Ordinance describe the laws with respect to import and export of goods in schedule 13 and the power to amend the schedule by the addition thereto or by the omission there from and regulate the conditions to import or export.

In the past, hazardous waste has not received much attention of the policy planners. However, Sri Lanka ratified the Basel Convention on the control of Trans-boundary Movement of Hazardous wastes and their disposal with effect from August 28, 1 992. Since *then,* significant attention has been drawn towards the movement of hazardous waste from outside sources to Sri Lanka. The Ministry of Forestry and Environment serves as the focal point for the convention. In the proposed National Environmental Protection Act, provisions have been made for the Ministry to give effect to the principles tinder Basal Convention.

(a) Guidelines on safety measures to be adopted during generation, collection, transportation, storage, recovery, recycling and disposal of wastes
(b) Guidelines for the establishment of waste disposal sites.
(c) Operation regarding recycling and recovery of waste.

A program for disposal of clinical waste in SOU1C selected hospital in the Colornbo Region is presently underway. The Ministry of health intends to prepare an Action Plan island—wide for the management of clinical of waste.

The Western Provincial Council has made arrangements to establish a Waste Management Authority and a draft Act is being developed for this purpose. The Ministry of' Provincial Councils and Local government also plans to establish a Waste Management Authority at National Level.

Some fiscal incentives are being given to industries under certain conditions to use advanced technology in order to minimize and control pollution i.e. cleaner production.

3.7.5 Legislation on hazardous waste

The proposed new National Environmental Act defines hazardous waste as 'those materials, substances and waste which have toxic, corrosive, radioactive, chemically reactive, flammable or explosive characteristics and which are listed by the Agency by Gazette notification time to time.'

The regulations concerning hazardous wastes have been published in the Gazette Extraordinary No. 924/13 of May 23, 1996. This came as an amendment to the National Environmental (Protection and Quality) Regulation No.1 of 1990, published in Gazette Extraordinary No. 595/16 of February 2, 1990. However, these regulations have hardly been enforced. In the proposed Environmental Bill, EPL regulations have been re-designated as Part I. New part two deals with hazardous waste management. This sets out requirements to obtain a license from the CEA and specifies the procedures for obtaining such licenses and conditions attached to them. Schedule one of Part II lists out 19 constituents and 9 waste streams indicating what should be considered hazardous waste.

Apart from the aforementioned regulations, there are other controls of certain hazardous

waste components, from different angles and standpoints. For instance, the following Acts have certain relevant provisions for hazardous material: Import and Export Act No. I of 1969 — This act has introduced a 'Special Import License (SIL) scheme relating to Security, Health, Environment and Public Morals. Those who intend to import any item under SIL require to apply to the Controller for a license. The Controller would then impose various conditions as appropriate (eg. Obtaining a certificate from Registrar of Pesticides) before exercising his/her discretion in favour of the importer.

Customs Ordinance (Chapter *235)* — The Schedule B of Customs Ordinance enumerates a table of prohibitions and restrictions for import and export. Sections 12(1), 43 and 44 of the Ordinance describe the laws with respect to import and export of goods in schedule B and the power to amend the schedule by the addition thereto or by the omission there from and regulate the conditions to import or export.

In the past, hazardous waste has not received much attention of the policy planners. However, Sri Lanka ratified the Basel Convention on the control of Trans-boundary Movement of Hazardous wastes and their disposal with effect from August 28, 1992. Since then, significant attention has been drawn towards the movement of hazardous waste from outside sources to Sri Lanka. The Ministry of Forestry and Environment serve as the focal point for the convention, in the new NLA, Provisions have been made for the Ministry to give effect to the principles under Basal Convention.

The government of Sri Lanka has made a policy decision to locate high polluting industries wherever possible within industrial estates provided with effluent disposal facilities. The National Environment Action Plan prepared by the ministry of Forestry and Environment lists out relevant issues and recommendations for the Industry Sector.
Guidelines for the implementation of hazardous waste management regulation have been prepared by the CEA, under the guidance of the Ministry of Forestry and Environment. These include,

a) Guidelines on safety measures to be adopted during generation, collection, transportation, storage, recovery, recycling and disposal of wastes.
b) Guidelines for the establishment of waste disposal sites.
c) Operation regarding recycling and recovery of waste.

Principal Implementing Bodies with regard to Hazardous Waste Management are the Ministry of Forestry and Environment **,** Central Environmental Authority and Local Authorities. In addition to these, a large number of institutions are responsible or management of hazardous wastes under various legislation enactments.

3.7. 6 Environmental impact assessment (EIA)

The EIA Process was first introduced to Sri Lanka by the Coastal Conservation Act of 1981 later in 1988 it was included in the National Environmental Act introducing EIA process to the entire Island.

An EIA is defined as "a written analysis of the predicted environmental consequences of a proposed project" [Section 33 of the EIA]. The same definition has been included in the Coast Conservation Act and amendment of 1993 to the Fauna and Flora Protection Ordinance. The Southern Development Authority Act of 1996 also contains the same definition.

The following contents must have been included in an EIA report

1. A description of the proposed PP;
2. Prediction of Environmental Consequences of the proposed PP;
3. Avoidable and unavoidable adverse impacts of the PP;
4. Description of irreversible and irretrievable commitment of resources for the PP;
5. Alternatives to the proposed PP
6. Reasons why these alternatives were rejected; and
7. An environmental cost / benefit analysis, if one has been prepared.

According to the definition of EIA, the EIA process is envisaged for individual projects. Every Prescribed project, whether undertaken by the Government or a private proponent must undergo the EIA process. For every prescribed project an EIA or an lEE must be prepared Prescribed projects were listed in the Gazette Notification No 772/22 of 24th June 1993 , and will be implemented through designated Project Approving Agencies (PPA) as prescribed by the Minister under section 23 Y of the NEA In Gazette Extra - Ordinary No 859/14 of 23rd February 1995. Under section 23 CC of the NEA, regulations have been made by the Minister stating the procedures that should be followed in order to achieve the EIA requirements of the NEA.

The Central Environmental Authority (CEA) as the agency charged with the responsibility of implementing the above provisions of the NEA, will promptly advise PPAs of any amendments to the NEA relevant to part IV C and/or the orders and regulations included in Gazette Extra ordinary No 772/ 22 of 24th June 1993.

The National Environmental Act had identified two levels in the EIA process: IEE and EIA

Initial Environmental Examination (IEE) is a report where possible impacts of a prescribed projects are assessed with a view to determining whether the impacts are significant or not. An IEE must address the possible impacts and the intensity of such impacts.

The EIA is a report which is a more comprehensive document whereby alternatives to the proposed project are considered and the option with the least impact on the environment identified and assessed Mitigation measures for the impacts identified as significant are part of an EIA. An environmental cost benefit analysis is also undertaken where ever possible.

The timing of the lEE/EIA is Crucial if it is to become a useful tool in decision making. If the timing is late then many important decisions would have been made. Project proponents are thus advised to come within the ETA process at a very early stage in the project cycle.

There are 5 major steps in the EIA process. First step is Preliminary Information. A project proponent is required to give the PAA preliminary information on the proposed prescribed project as early as possible . The preliminary information submitted should be comprehensive and may even suffice to be considered as IEE.

Second step is Environmental scooping is the process of identifying the important issues which must be addressed in detail in the EIA.

The next step is public participation. It is one of the most crucial aspect of the EIA process. The Provisions for public participation is contained in the NEA.

Decision making is the next step. According to the regulations, the PAA shall grant approval for the project subject to specified conditions or refuse approval for the implementation of the project with reasons for doing so.

The next step is monitoring. The success of the EIA process would be totally negated if the conditions imposed by the PAA are not effectively monitored. EIA report must be in a recommended format. Agencies should use a format for EIAs that will encourage good analysis and clear presentation of the Alternatives including the proposed action.

The text of EIA (excluding appends) should normally be less than 50 pages. For proposals unusual scope or complexity it should normally be no more than 100 pages. EIA should be written in plain language and may use appropriate graphics so that decision makers and the public can readily understand them. EIA's may he written in English, Tamil or Sinhala. I3ut it is advisable to make available it in Sinhala. But it is advisable to make available it in Sinhala or Tamil at the public inspection.

Central Environmental Authority had prepared guidelines for an Extended Benefit Cost Analysis for the use of the project proponents to make an Extended Benefit Cost Analysis for the projects. And also the project proponents should ensure the professional integrity, including scientific integrity of the discussions and analyses in EIAs.

After an EIA is prepared, the project proponent must submit it to the PAA who must check its adequacy against terms of reference. [EIA regulation 11(i)] In the case of an IEE there is no such requirement to check the adequacy. If the PAA is not satisfied with the EIA, then it should ask the project proponent to make the necessary amendments and resubmit it [EIA regulation II (ii)] 'the PAA must thereafter publish not ice in the *gazette* and in daily newspapers in all 3 languages inviting the public to inspection and make comments on the EIA /IEE within 30 days. [NEA, section 23BB(2) read with EIA

regulations 8(u) and 12(u)] These costs are to be pre-estimated and collected before scooping as administrative charges from the project before scooping as administrative charges from the project proponent. ETA regulations 7 (iii)] The notice should say where and when the EIA /lEE can he inspected. [NEA, section 23BB(2) read with EIA regulations (iii) and 12(u)] Once the public comment period is over the PAA must decide whether the case warrants a public hearing. [NEA, section 23BB(3)] At the conclusion t the hearing and! or comment period, the PAA must send the project proponent for review and comment.[EIA regulations 12 & 9(i) When the response is received, the PAA has seven days in the case of an lEE and 30 days in the case of an EIA to make its approval decision [EIA regulations 10 & 14].

In the case of an TEE, the PAA can grant approval with conditions or refuse approval (giving reasons) or call for an ETA where significant impacts are disclosed. [EIA regulations 10] In the case of an ETA, the PAA can grant approval with conditions or refuse approval with reasons. [EIA regulation 14]

When the PAA approves a project proposal with or without conditions, a notice of this fact must be published in the gazette and in the daily newspapers in the three languages. [NEA, Section 23BB (4) read with EIA regulation 17] The approval remains valid for 24 months [EIA regulation I 8] where approval is refused, the project proponent has a right to appeal to the secretary of the Ministry of Environment [NEAS' 23 DD read with EIA regulation 15]. There is no time limit fixed for the appeal and, therefore, it may be lodged within a reasonable period of time. The appeal must be in writing and the Secretary may hear the appellant in support if his appeal. The secretary can confirm, reject or modify the PAA's decision.

The Central Environment Authority had prepared guidelines for implementation of the EIA process in three volumes. (1) A general Guide for Project Approving Agencies (PAA) (2) A General Guide for Conducting Environmental Scooping. (3) Public Participation Handbook. In addition to these, several sectoral guidelines have been prepared by the CEA.

The project - oriented focus of the ElAs process could be considered as a drawback in the process. Because EIA are prepared for individual projects, the cumulative impacts of projects could be overloaded. It is desirable to prepare EIAs at the strategic level on a regional basis once development projects for a particular region have been identified. Though NEA envisages the preparation on EIA reports for individual projects, it does not rule out macro-level planning or the preparation of EIAs on a macro level. On the contrary, the NEA itself requires the preparation of a land **use** scheme for Sri Lanka.

For macro level EIA planning, the word 'effects' in the defluxion of an EIA in Article 33 of the NEA could be interpreted as including commutative environmental effects. The guidelines prepared by the CEA for implemental ion of the EIA process recognise the importance of discussing the cumulative impacts of Projects where the impacts of individual Projects may be insignificant, hut cumulatively may give rise to a Significant

impacts. The individual project base EIA process can overlook the overall consequences or the Cumulative impacts of the activities. This seriously undermines the important role played by EIAs as a tool to achieve sustainable development.

3.7. 7 National Environmental Act No. 47 of 1980

This is the national framework legislation in the field of environment which empowers Central Environmental Authority for the implementation of policies and strategies for the protection and management of the environment in Sri Lanka (Section 10 of the NEA of 1998).

The NEA states that no person shall discharge, deposit, or emit waste into the environment which will cause pollution except under the authority of license issued by the Central Environmental Authority; and in accordance with standards and other criteria as may be prescribed under this act. It also prohibits the pollution of the atmosphere by any physical, chemical or biological condition that make the atmosphere or part of it unclean, noxious, poisonous, impure, detrimental to health, welfare, safety property of human beings, poisonous or harmful to animals and other wildlife. It also prohibits the disposal of waste and hazardous materials to the atmosphere, waters or soil. In this act it is also stated that minister may make regulations in respect to matters stated or are required by this act. For instance, regulations on the specification of ambient air quality standards and emission and specifying the maximum permissible concentration of any matter that may be present in or discharged into the atmosphere; regulations on prohibition of the discharge, emission or deposit to the environment of any matter, whether liquid, solid or gases or of radio activity and prohibition or regulating the use of any specified fuel. It also provides for the prohibition of the use of any equipment, facility, vehicle or boat capable of causing pollution or regulating the construction, installation, or operation thereof so as to prevent or minimize pollution.

Sections 23 of the National Environmental Act (NEA) of 1980, which was amended in 1988, prohibit emission of pollutants into the atmosphere. Although discharge standards have been prescribed for liquid wastes, and the Sri Lanka Standards Institution (SLSI) has prescribed emission standards for sulphuric acid plants, these regulations do not address vehicular air pollution. Though the NEA has given the mandate to the CEA to regulate and control air pollution, little has been achieved in this area due to lack of appropriate regulations. Amendments to the Motor Traffic Act have given sufficient authority to the Department of Motor Traffic and Police Department to control vehicular emissions.

This Act also provide for the protection, management and enhancement of the environment, for the regulation, maintenance and control of the quality of the environment and to prevent, abatement and control of pollution. According to this Act, no one can deposit or emit waste into the inland waters of Sri Lanka and no one shall pollute the Sri Lankan waters. Offenders will be punished.

Procedures for obtaining necessary clearance for establishing new projects have been detailed. For each of the industrial sectors and the nature of the environmental impacts anticipated, a screening committee of competent personnel is established, to consider the proposal. Public is also provided an opportunity to make comments and suggestions on the project proposal. Aggrieved persons have a right to appeal against the proposal or the decision taken to establish the project. The decision of the Secretary to the Ministry, on such appeal, shall be final.

Sections 23 J and K of the National Environmental Act (NEA) of 1980, which was amended in 1988, prohibit emission of pollutants into the atmosphere. Although discharge standards have been prescribed for liquid wastes, and the Sri Lanka Standards Institution (SLSI) has prescribed emission standards for sulphuric acid plants, these regulations do not address vehicular air pollution.

Though the NEA has given the mandate to the CEA to regulate and control air pollution, little has been achieved in this area due to lack of appropriate regulations. Amendments to the Motor Traffic Act have given sufficient authority to the Department of Motor Traffic and Police Department to control vehicular emissions. An increase in awareness has led to the recognition of the need for increased regulatory control and policy formulation including the formulation of the Clean Air 2000 – Action Plan.

National Environmental Act 47 or 1980, amended by Act 56 of 1988 stated that no person shall discharge, deposit, or emit waste into the environment which will cause pollution except under the authority of license issued by the Central Environmental Authority; and in accordance with standards and other criteria as may be prescribed under this act.

It also prohibits the pollution of the atmosphere by any physical, chemical or biological condition that make the atmosphere of part of it unclean, noxious, poisonous, impure, detrimental to health, welfare, safety property of human beings, poisonous or harmful to animals and other wildlife. It also prohibits the disposal of waste and hazardous materials to the atmosphere, waters or soil.

In this act it is also stated that minister may make regulations in respect to matters stated or are required by this act. For instance, regulations on the specification of ambient air quality standards and emission and specifying the maximum permissible concentration of any matter that may be present in or discharged into the atmosphere; regulations on prohibition of the discharge, emission or deposit to the environment of any matter, whether liquid, solid or gases or of radio activity and prohibition or regulating the use of any specified fuel.

It also provides for the prohibition of the use of any equipment, facility, vehicle or boat capable of causing pollution or regulating the construction, installation, or operation thereof so as to prevent or minimize pollution.

CHAPTER 4 - NATIONAL SECTOR BASELINES FOR CDM PROTECT ACTIVITIES

Since most of CDM projects in Sri Lanka are small scale, this chapter discusses only the sector baselines of small scale CDM projects.

4.1 Small scale baseline methodology applicable to Sri Lanka

In terms of modalities and procedures for the CDM, three types of small-scale CDM projects are possible.

Type i – Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts or appropriate equivalent (Decision 17/CP.7 para 6 (c) (i).

Type ii – Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 GWh per year (Decision 17/CP.7 para 6 (c) (ii).

Type iii – Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotons(kt)of carbon dioxide equivalent annually (Decision 17/CP.7 para 6 (c) (iii)..

Each of these project types has several project categories (i.e. catrgory 1.A, I.B, I.C,I.D. and II.A etc.) Under these three types of project the CDM executive board has approved 19 indicative simplified methodologies. Table …. presents all approved small scale methodologies by the Executive board. Project developers may use these approved methodologies as appropriate or use new methodologies. Details of these methodologies can be obtained from the website http:/cdm.unfccc.int/methodologies/SSCmethodologies/approved

4.2 National Baseline for small scale CDM projects in renewable energy

4.2.1 Baseline emissions – Type I - Category I.D – Renewable power generation for a grid

Among the approved small scale methodologies Type 1- Category 1.D which is renewable power generation for a grid is mostly relevant to Sri Lanka. Most of the proposed CDM projects in Sri Lanka come under this category. Therefore most recent methodologies for estimation of baseline emissions for Type 1- Category I.D are discussed below.

The most recent approved Simplified Baseline Methodologies for Small Scale CDM Projects Activity Categories I.D, renewable power generation for grid are presented at the

I.D/Version 09, Scope 1 dated 28 July 2006 [1] of the Appendix B. According to Para 9 (a) of Type I, I.D/Version 9 dated 28 July 2006, the baseline for Sri Lanka is the kWh of electrical power produced by the renewable generating unit multiplied by an emission coefficient (measured in kg CO2equ/kWh) calculated in a transparent and conservative manner as:

> (a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the approved methodology ACM 0002. Any of the four procedures specified in the ACM 0002 to calculate the operating margin can be chosen, but restrictions to use the Simple OM and Average OM calculations must be considered (Para 9 (a) of the I.D/Version 09, Scope 1 dated 28 July 2006.
>
> OR,
>
> (b) The weighted average emissions (in kg CO2equ/kWh) of the current generation mix. The data of the year in which project generation occurs must be used (Para 9 (a) of the I.D/Version 09, Scope 1 dated 28 July 2006.

Of these two methods, the option (a) is beneficial for Sri Lanka, since the option (b) derive very low emission factor. This is because Sri Lanka has a large share of hydro-power.

The approved methodology ACM 0002 provides formulas for calculation of combine margin (CM), build margin (BM) and operation margin (OM).

4.2.2 Operating Margin (OM)

The ACM 0002 provides four options to calculate operating margin (OM):

a) Simple operating margin
b) Simple adjusted operating margin
c) Dispatch data analysis operating margin
d) Average operating margin

Of these four options, Simple Adjusted OM method is appropriate for Sri Lanka since there are no detail data are available to use Dispatch Data Analysis OM.

The simple adjusted OM can be derived using following formula:

$$EF_{OM,y} = (1-\lambda_y) * \frac{\sum_{i,j} F_{i,j,y} COEF_{i,j}}{\sum_{j} GEN_{j,y}} \quad + \quad \lambda y * \frac{\sum_{i,j} F_{i,k,y} COEF_{i,k}}{\sum_{k} GEN_{k,y}}$$

Where $F_{i,j,y}$ is amount of fuel i (in mass or volume unit) consumed by relevant power sources j in year(s), y. j refers to power sources delivering electricity to the grid from the sources other than low operating cost and must run power plants and k refers to power sources delivering electricity to the grid from the low operating cost and must run power plants.

$$\lambda = \frac{Numberofhoursperyearforwhichlow-cost/mustrunresourcesare\,in\,the\,margin}{8760 hoursperyear}$$

Where λ should be calculated as follows:

Step 1- Plot a load duration curve. Collect chronological load data (typically in MW) for each hour of a year, and sort data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order

Step 2 – Organize data by generating sources. Collect data for, and calculate total annual generation (in MWh) from low-cost must-run resources (i.e. $GEN_{k,y}$)

Step 3 - Fill load duration curve. Plot horizontal line across load duration curve such that area under the curve (MW times hours) equal the total generation (in MWh) from low-cost must-run resources (i.e. $GEN_{k,y}$)

Step 4 – Determine the "Number of hours per year for which low-cost must run resources are on the margin". First locate the intersection of the horizontal line plotted in step 3 and the load duration curve plotted in step 1. The number of hours (out of total 8760 hours) to the right of the intersection is the numbers of hours for which low-cost must run resources are on the margin. If the line do not intersect, one may conclude that low-cost must run resources do not appear on the margin and λ is equal to 0. Lambda λ is the calculated number of hours divided by 8760.

$COEF_{i,j}$ is the CO_2 emission coefficient of fuel i (t/CO_2 mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j, and the present oxidation of the fuel in year(s), y, and $GEN_{j,y}$ is the electricity (MWh) delivered to the grid by the source j.

The CO_2 coefficient $COEF_i$ was obtained as

$COEF_i = NCV_i * EF_{CO2i} * OXID_i$

Where

NCV_i is the net calorific value (energy content) of per mass or volume unit of a fuel I, and $OXID_i$ is the oxidation factor of the fuel. The EF_{CO2i} is the CO2 emission factor per unit of energy of the fuel $_i$.

Using this formula simple adjusted OM should be calculated most recent three years and get the average based on the most recent statistics available at the time of PDD submission.

4.2.3 Build Margin (BM)

The Build Margin emission factor ($EF_{BM,y}$) can be calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plant m, as follows:

$$EF_{BM,y} = \frac{\sum_{i,j} F_{i,m,y} COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Where $E_{i,m,y}$ $COEF_{i,m}$ and $GEN_{m,y}$ are analogous to variables described for the OM method above for plants m. The sample group m should consist of either the five power plants that have been built most recently, or power plant capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

For Sri Lanka, the option 1 is most appropriate to calculate the BM which should be calculated ex-ante based on the most recent information available for plants already built for sample group m at the time of PDD submission.

The total capacity of the Sri Lankan power system is 2194.5 MW. The total annual average energy generated by the entire system is 11715 GWh; 20% of this is 2343 GWh.. The most recent five power plants have the capacity of 453 MW and average annual energy of 3176 GWh. Therefore, the five most recently commissioned power plants were used in estimating “build margin” emission coefficient for Sri Lanka.

4.2.4 Calculation of baseline emission factor

Baseline emission factor should be calculated as the weighted average of the operating margin emission factor ($EF_{OM,y}$) and build margin emission factor ($EF_{BM,y}$) as

$EF_y = w_{OM} * EF_{BM,y} + w_{BM} * EF_{BM,y}$

Where weights w_{OM} and w_{BM}, by deault, are 50% (i.e $w_{OM} = w_{BM} = 0.5$) and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated calculated using above formulae (ref. ACM0002)

4.2.5 Application of the combined margin (CM) to Sri Lanka

The weighted average emission baseline in $kgCO_2$/year for Sri Lanka in terms of the procedures prescribed in the approved methodology I.D/Version 09, Scope 1 dated 28 July 2006 (Para 9 (a) and ACM 0002 which was calculated based on the combine margin (CM) consisting of the combination of operating margin (OM) and build margin (BM).

4.2.5.1 Calculation of emission factors for each power plants

In order to estimate the average emissions of each power plant in the system the relative power contribution of each thermal power plant should be estimated. The contributions of each power plant to the system were estimated using following formulae (Table 14, 15, 16, 17, 18 & 19).

Following formulae was used to estimate the effective total operating hours per year:

Total effective operating hours (D) = 8760 hour/year (A) - maintenance hours per year (B) – forced outage rate in % (C)

D = (A - B) * ((100 – C)/100) Where:

D = Total effective operating hours/year
A = 8760 hours/year
B = maintenance hours
C = forced outage (%)

Maximum annual energy output (kWh/year) of each power plant was calculated using following formulae:

Annual Energy Output in kWh/year (F) = Operating hours (D) * Plant capacity in MW (E) * 10^3

F = D * E * 10^3 Where:

D = Total effective operating hours
E = Plant capacity in MW
F = Annual energy output in kWh/year

The percentage power contribution of each power plant (% of kWh/year) was calculated using following formulae:

Percentage power of each power plant in % (G) = Annual output of each power plant (Fi)/ Sum of output of all power plants (Σ F_1 ……. N)

$G = Fi / \Sigma F_1 \ldots\ldots N$ where

G = Contribution to total energy supply by each plant (%)
F_i = Energy output of the ith power plant

Heat rates of each power plant (MJ/MWh) were calculated using following formulae:

Plant heat rate (MJ/MWh) = (1/plant conversion efficiency) * 3.6 * 10^3

$J = [(1/ H) * 3.6 * 10^3]$ where,

J = Plant heat rate (MJ/MWh)
H = Plant conversion efficiency (%)

Source: Plant Conversion Efficiency Rates were received from CEB Generation Plans, 2003, 2004 and 2005 [8, 9 & 16]. IPCC recommended conversion factor: 1 MWh = 3.6 *10^9 J or 1 MWh = 3.6 * 10^3 MJ [12]

Adjusted carbon contents of fuel for each power plant were calculated using following equation:

Adjusted carbon content of fuel for each power plant (tC/TJ) = Carbon content of each fuel * Combustion efficiency of power plant

M = K * L where:
M = Adjusted carbon content of each fuel (tC/TJ)
K = Carbon content of each fuel
L = Combustion efficiency of power plant

Note: Combustion efficiency of all plants is assumed to be 99%.

Emission factors (kgC/MWh) of each power plant were calculated using following equation.

Emission factor (kgC/MWh) = (Heat rate * adjusted carbon content of fuel * 10^3) /10^6

$N = (J * M * 10^3) / 10^6$. where,

N = Emission factor in kgC/MWh)
J = Heat rate (MJ/MWh)
M = Adjusted carbon content of fuel (tC/TJ)

The following equation was used to convert kgC/MWh into CO_2 emission per kWh:

$O = [(N * 44/12) / 10^3]$ where:

O = CO_2 emissions (kg CO_2/kWh)
N = Emission factor (kgC/MWh)

4.2.5.2 Operating margin emission calculation

According to the Appendix B, I.D/Version 9, Paragraph 9 (a), the "approximate operating margin" is the weighted average emissions (in kg CO_2equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. This was calculated using the Option 1 of paragraph 9 (c) of the approved baseline methodology, Type I – Renewable Energy Projects; Category I.D./Version 09, Scope 1, 28 July 2006. According to this the approximate operating margin is a 3 – year average, based on the most recent statistic available at the time of PDD submission [10].

Therefore approximate operating margin emissions were calculated for years 2003, 2004 and 2005 separately. Then the three year average was calculated. The weighted average emissions of approximate operating margin for each year were calculated using following formulae:

Weighted average emissions of the year i (kgCO_2/kWh) = CO_2 emissions of ith power plant * Percentage of power contribution of a power plant to the grid

P_i = O * G where:

O = CO_2 emissions of each power plant
P_i = Weighted average emissions (kg CO_2/kWh)
G = Contribution of total energy supply by each power plant (%)

The approximate operating margin for the given year was estimated taking the sum of the weighted average emissions of all the power plants operating in the year using following equation:

Weighted average emissions of all plants in the year 1 (kg CO_2/kWh) = Sum of emissions factors of all thermal power plants i.e. plant i. to plant n

Q_1 = (Σ P_1……..n)

Q_1 = Weighted average emissions of all thermal plants in the year 1 (kg CO_2/kWh) = Sum of emission factors of all thermal power plants – plant i …. n

A three year average of approximate operating margin was calculated using following equation:

$$OM = \frac{[\sum Q_{1.....3}] * \lambda}{3}$$

Where

OM = Operating margin emission factor (A three year average of the approximate margin emissions)

$Q_{1....3}$ = Weighted average emission factors of year 1 to 3

OM = λ * (0.723 + 0.685 + 0.698)/3

OM = …… kg CO_2/kWh - This can be calculated once lambda is calculated

The analysis found that the approximate operating margin emission factor of Sri Lanka is 0.702 kg CO_2/kWh (to be adjusted with Lambda). This is a three year average of approximate operating margins of years 2003, 204 and 2004. The table 13 presents the weighted average approximate emission factors for year 2003, 2004 and 2005 and the average of emission factors of all these three years. Data, formula and calculation results of approximate margin for years 2003, 2004, and 2004 are presented in Tables 14, Table 15, Table 16, Table 17, and Table 18 and Table 19 respectively.

Table 13 - Weighted average approximate emission factors

Year	Weighted average emmisons factor kg CO_2/kWh
2003	0.723
2004	0.685
2005	0.698
Approximate operating margin OM (Average emission factors of 2003, 2004 and 2005)	**0.702**

4.2.5.3 Build margin (BM) emission calculation

According to the Appendix B, I.D/Version 9, Scope 1, dated 28 July 2006 Paragraph 9 (a) and the ACM 0002 the "build margin" is the weighted average emissions (in kg CO2equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the five most recent plants." [10]. The most recent five power plants in Sri Lanka account for more than 20% of the total MWh generated in the system. The following formulae was used to estimate the build margin weighted average emission:

Weighted average emissions of five most recent plants addition to the grid (kg CO_2/kWh) = CO_2 emissions of each of the five most recent power plants * percentage of power contribution to the grid by five most recent power plants

T_i = S * R where:

T_i = Weighted average emissions of ith power plant of the five most recent power plants additions to the grid ($kgCO_2/kWh$)
S = CO_2 emissions of each of the most recent five power plants
R = Percent contribution of power to the grid from these recent five power plants

$BM = \sum T_{1.....5}$

BM = Build Margin emission factor (Weighted average emissions of five most recent plants addition to the grid (kg CO_2/kWh)

BM = 0.584 kg CO_2/kWh

The sum of weighted average emissions of most recent five power plants added to the grid, which is the build margin emission factor, was found to be 0.584 kg CO_2/kWh (Table 20 and Table 21).

4.2.5.4 Baseline emission factor

Combined Margin (CM) emission factor was estimated based on weighted average operating margin (OM) and build margin (BM) emission factors using following equation:

$EF_y = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$

Where

EF_y = Baseline emission factor defined as Combine Margin emission factor (kg CO_2/kWh)
$EF_{BM,y}$ = Operating margine mission factor (kg CO_2/kWh)
$EF_{BM,y}$ = Build margine mission factor for the base year (kg CO_2/kWh)
w_{OM} = 0.5
w_{BM} = 0.5

EF_y = 0.5 * 0.702 (adjusted with Lmbda) + 0.5 * 0.584 = …. kg CO_2/kWh

The Baseline Emission factor which is standardized baseline for annual emissions offset value that would result from the implementation of the Ampara EnerGeon Small Scale Biomass Power project is 0.643kg CO_2 per kWh.

Table 14 -Data and formulae used for approximate margin average emission calculations for year 2003 (Part 1)

Power plant	Date of commissioning	Fuel source	Hours /yr	Maintenance (hours/ yr)	Forced outage %	Total Operating hours	Capacity (MW)	Annual maximum energy (kWh/yr)
Variable			**A**	**B**	**C**	**D**	**E**	**F**
						(A – B) * ((100 – C)/100)		**F=D*E*1000**
CEB operated power plants								
1.Kelanitissa Gas turbines (old)	1982	Auto diesel	8760	960	20	6240	48	299520000
2. Kelanitissaa Gas turbines (new)	1997	Auto diesel	8760	1080	8	7065.6	115	812544000
3. Sapugaskanda Diesel	1984	Residual oil	8760	1200	30	5292	72	381024000
4. Sapugaskanda Diesel extension	1999	Residual oil	8760	1056	99915	6548.4	72	471484800
5. Kelanitisaa Combined Cycle (JBIC)	2002	Naphtha	8760	768	5	7592.4	165	1252746000
Independent power producers								
6. Lakdhanavi diesel	1997	Fuel oil	8760	720	8	7396.8	22.5	166428000
7. Asia power Ltd diesel	1998	Fuel oil	8760	720	8	7396.8	49	362443200
8. Colombo Power Ltd diesel	2000	Fuel oil	8760	720	8	7396.8	60	443808000
9. Ace Power Matara diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
10. ACE Power Horana diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
							643.5	**4485870000**

Table 15 - Data and formulae used for approximate margin average emission calculations for year 2003 (Part 2)

Variable - Power plants	Contribution to total energy supply (% of kWh)	Plant conversion efficiency factor	Heat rate (MJ/MWh)	Carbon content (tC/TJ)	Combistion efficiency factor	Adjusted Carbon content (tC/TJ)	Emissions factor (kgC/MWh)	Emissions factor (kg CO2/kWh)	Weighted average emmisions (kgCO2/kWh)
	G	H	J	K	L	M	N	O	P
	G=(Fi/ΣF..n)*100		J=(1/H)*3.6*1000			M=K*L	N=J*M*10^3/10^6	O=(N*44/12)/10^3	P=O/100*G
CEB operated power plants									
1.Kelanitissa Gas turbines (old)	6.6770	0.2200	16363.6364	20.2	0.99	19.9980	327.2400	1.1999	0.0801
2. Kelanitissaa Gas turbines (new)	18.1134	0.3000	12000.0000	20.2	0.99	19.9980	239.9760	0.8799	0.1594
3. Sapugaskanda Diesel	8.4939	0.3850	9350.6494	21.1	0.99	20.8890	195.3257	0.7162	0.0608
4. Sapugaskanda Diesel extension	10.5104	0.4080	8823.5294	21.1	0.99	20.8890	184.3147	0.6758	0.0710
5. Kelanitisaa Combined Cycle (JBIC)	27.9265	0.4710	7643.3121	20.2	0.99	19.9980	152.8510	0.5605	0.1565
Independent power producers									
6. Lakdhanavi diesel	3.7100	0.4000	9000.0000	21.1	0.99	20.8890	188.0010	0.6893	0.0256
7. Asia power Ltd diesel	8.0797	0.4000	9000.0000	21.1	0.99	20.8890	188.0010	0.6893	0.0557
8. Colombo Power Ltd diesel	9.8935	0.4000	9000.0000	21.1	0.99	20.8890	188.0010	0.6893	0.0682
9. Ace Power Matara diesel	3.2978	0.4000	9000.0000	21.1	0.99	20.8890	188.0010	0.6893	0.0227
10. ACE Power Horana diesel	3.2978	0.4000	9000.0000	21.1	0.99	20.8890	188.0010	0.6893	0.0227
	100.0000								**0.7228**

Table 16 -Data and formulae used for approximate margin average emission calculations for year 2004 (Part 1)

Power plant	Date of commissioning	Fuel source	Hours /yr	Maintenance (hours/ yr)	Forced outage %	Total Operating hours	Capacity (MW)	Annual maximum energy (kWh/yr)
Variable			**A**	**B**	**C**	**D**	**E**	**F**
						(A – B) * ((100 – C)/100)		**F=D*E*1000**
CEB operated power plants								
1.Kelanitissa Gas turbines (old)	1982	Auto diesel	8760	1008	17	6434.16	51	328142160
2. Kelanitissaa Gas turbines (new)	1997	Auto diesel	8760	1440	16	6148.8	115	707112000
3. Sapugaskanda Diesel	1984	Residual oil	8760	1128	14	6563.52	72	472573440
4. Sapugaskanda Diesel extension	1999	Residual oil	8760	1320	6	6993.6	72	503539200
5. Kelanitisaa Combined Cycle (JBIC)	2002	Naphtha	8760	528	5	7820.4	165	1290366000
Independent power producers								
6. Lakdhanavi diesel	1997	Fuel oil	8760	720	8	7396.8	22.5	166428000
7. Asia power Ltd diesel	1998	Fuel oil	8760	720	8	7396.8	49	362443200
8. Colombo Power Ltd diesel	2000	Fuel oil	8760	720	8	7396.8	60	443808000
9. Ace Power Matara diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
10. ACE Power Horana diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
11.AES Kelanitissa (Pvt) Ltd. (ADB)	2003	Auto diesel	8760	720	8	7396.8	163	1205678400
12. Heladhanavi (Pvt) Ltd.	2004	Fuel oil	8760	720	8	7396.8	100	739680000
							909.5	**6515642400**

Table 17 - Data and formulae used for approximate margin average emission calculations for year 2004 (Part 2)

Variable - Power plants	Contribution to total energy supply (% of kWh)	Plant conversion efficiency factor	Heat rate (MJ/MWh)	Carbon content (tC/TJ)	Combistion efficiency factor	Adjusted Carbon content (tC/TJ)	Emissions factor (kgC/MWh)	Emissions factor (kg CO2/kWh)	Weighted average emmisions (kgCO2/kWh)
	G	H	J	K	L	M	N	O	P
	G=(Fi/ΣF..n) *100		J=(1/H)*3.6* 1000			M=K*L	N=J*M* $10^3/10^6$	O=(N*44/12)/ 10^3	P=O/100*G
CEB operated power plants									
1.Kelanitissa Gas turbines (old)	5.04	0.218	16513.761	20.2	0.99	19.998	330.24220	1.2108880	0.060983001
2. Kelanitissaa Gas turbines (new)	10.85	0.33	10909.090	20.2	0.99	19.998	218.16	0.79992	0.086811552
3. Sapugaskanda Diesel	7.25	0.382	9424.0837	21.1	0.99	20.889	196.85968	0.7218188	0.052352845
4. Sapugaskanda Diesel extension	7.73	0.415	8674.6987	21.1	0.99	20.889	181.20578	0.6644212	0.051347527
5. Kelanitisaa Combined Cycle (JBIC)	19.80	0.48	7500	20.2	0.99	19.998	149.985	0.549945	0.108911798
Independent power producers									
6. Lakdhanavi diesel	2.55	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.017607623
7. Asia power Ltd diesel	5.56	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.038345491
8. Colombo Power Ltd diesel	6.81	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.046953663
9. Ace Power Matara diesel	2.27	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.015651221
10. ACE Power Horana diesel	2.27	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.015651221
11.AES Kelanitissa (Pvt) Ltd. (ADB)	18.50	0.42	8571.4285	20.2	0.99	19.998	171.41142	0.6285085	0.116301534
12. Heladhanavi (Pvt) Ltd.	11.35	0.42	8571.4285	21.1	0.99	20.889	179.04857	0.6565114	0.074529623
	100.00								**0.6854471**

Table 18 - Data and formulae used for approximate margin average emission calculations for year 2005 (Part 1)

Power plant	Date of commissioning	Fuel source	Hours /yr	Maintenance (hours/ yr)	Forced outage %	Total Operating hours	Capacity (MW)	Annual maximum energy (kWh/yr)
Variable			**A**	**B**	**C**	**D**	**E**	**F**
						(A – B) * ((100 – C)/100)		**F=D*E*1000**
CEB operated power plants								
1.Kelanitissa Gas turbines (old)	1982	Auto diesel	8760	864	20	6316.8	68	429542400
2. Kelanitissaa Gas turbines (new)	1997	Auto diesel	8760	240	10	7668	115	881820000
3. Sapugaskanda Diesel	1984	Residual oil	8760	1200	17	6274.8	72	451785600
4. Sapugaskanda Diesel extension	1999	Residual oil	8760	1200	12	6652.8	72	479001600
5. Kelanitisaa Combined Cycle (JBIC)	2002	Naphtha	8760	720	6	7557.6	165	1247004000
Independent power producers								
6. Lakdhanavi diesel	1997	Fuel oil	8760	720	8	7396.8	22.5	166428000
7. Asia power Ltd diesel	1998	Fuel oil	8760	720	8	7396.8	49	362443200
8. Colombo Power Ltd diesel	2000	Fuel oil	8760	720	8	7396.8	60	443808000
9. Ace Power Matara diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
10. ACE Power Horana diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
11.AES Kelanitissa (Pvt) Ltd. (ADB)	2003	Auto diesel	8760	720	8	7396.8	163	1205678400
12. Heladhanavi (Pvt) Ltd.	2004	Fuel oil	8760	720	8	7396.8	100	739680000
13. ACE Power Embilipitiya Ltd.	2005	Fuel oil	8760	720	8	7396.8	100	739680000
							1026.5	**7442743200**

Table 19 - Data and formulae used for approximate margin average emission calculations for year 2005 (Part 2)

Variable - Power plants	Contribution to total energy supply (% of kWh)	Plant conversion efficiency factor	Heat rate (MJ/MWh)	Carbon content (tC/TJ)	Combistion efficiency factor	Adjusted Carbon content (tC/TJ)	Emissions factor (kgC/MWh)	Emissions factor (kg CO2/kWh)	Weighted average emmisions (kgCO2/kWh)
	G	H	J	K	L	M	N	O	P
	G=(Fi/ΣF..n) *100		J=(1/H)*3.6*1000			M=K*L	N=J*M*10^3/10^6	O=(N*44/12)/10^3	P=O/100*G
CEB operated power plants									
1.Kelanitissa Gas turbines (old)	5.77	0.205	17560.961	20.2	0.99	19.998	351.18439	1.28767609	0.07431554
2. Kelanitissaa Gas turbines (new)	11.85	0.33	10909.090	20.2	0.99	19.998	218.16	0.79992	0.094774928
3. Sapugaskanda Diesel	6.07	0.382	9424.0837	21.1	0.99	20.889	196.85968	0.72181884	0.043815479
4. Sapugaskanda Diesel extension	6.44	0.415	8674.6987	21.1	0.99	20.889	181.20578	0.66442120	0.042760957
5. Kelanitisaa Combined Cycle (JBIC)	16.75	0.48	7500	20.2	0.99	19.998	149.985	0.549945	0.092141244
Independent power producers									
6. Lakdhanavi diesel	2.24	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.015414341
7. Asia power Ltd diesel	4.87	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.033569008
8. Colombo Power Ltd diesel	5.96	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.041104908
9. Ace Power Matara diesel	1.99	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.013701636
10. ACE Power Horana diesel	1.99	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.013701636
11.AES Kelanitissa (Pvt) Ltd. (ADB)	16.20	0.42	8571.4285	20.2	0.99	19.998	171.41142	0.62850857	0.101814504
12. Heladhanavi (Pvt) Ltd.	9.94	0.42	8571.4285	21.1	0.99	20.889	179.04857	0.65651142	0.065245886
13. ACE Power Embilipitiya Ltd.	9.94	0.42	8571.4285	21.1	0.99	20.889	179.04857	0.65651142	0.065245886
	100.00								**0.697605953**

4.2.5.5 Calculation of build margin average emissions (BM)

Table 20 and Table 21 provide data and the results of the build margin emission calculations.

Table 20 - Data and formulae used for build margin average emission calculations as at year 2005 (Part 1)

Power plant	Date of commissioning	Fuel source	Hours /yr	Maintenance (hours/ yr)	Forced outage %	Total Operating hours	Capacity (MW)	Annual maximum energy (kWh/yr)
Variable			**A**	**B**	**C**	**D**	**E**	**F**
						(A - B) * ((100 – C)/100)		**F=D*E*1000**
1. Kukule hydro power	2003	Hydro					70	300000000*
2. ACE Power Horana diesel	2002	Fuel oil	8760	720	8	7396.8	20	147936000
3.AES Kelanitissa (Pvt) Ltd. (ADB)	2003	Auto diesel	8760	720	8	7396.8	163	1205678400
4. Heladhanavi (Pvt) Ltd.	2004	Fuel oil	8760	720	8	7396.8	100	739680000
5. ACE Power Embilipitiya Ltd.	2005	Fuel oil	8760	720	8	7396.8	100	739680000
							453	**3132974400**

*** CEB Generation and Expansion Plan – December 2005**

Table 21 - Data and formulae used for build margin average emission calculations as at year 2005 (Part 2)

Variable - Power plants	Contribution to total energy supply (% of kWh)	Plant conversion efficiency factor	Heat rate (MJ/MWh)	Carbon content (tC/TJ)	Combistion efficiency factor	Adjusted Carbon content (tC/TJ)	Emissions factor (kgC/MWh)	Emissions factor (kg CO2/kWh)	Weighted average emmisions (kgCO2/kWh)
	R	**H**	**J**	**K**	**L**	**M**	**N**	**S**	**T**
	G=(Fi/ΣF..n)*100		**J=(1/H)*3.6*1000**			**M=K*L**	**N=J*M*10^3/10^6**	**O=(N*44/12)/10^3**	**P=S/100*R**
1. Kukule hydro	9.58								
2. ACE Power Horana diesel	4.72	0.4	9000	21.1	0.99	20.889	188.001	0.689337	0.032549822
3..AES Kelanitissa (Pvt) Ltd. (ADB)	38.48	0.42	8571.4285	20.2	0.99	19.998	171.4114	0.628508571	0.241872136
4. Heladhanavi (Pvt) Ltd. –Puttalama	23.61	0.42	8571.4285	21.1	0.99	20.889	179.0485	0.656511429	0.154999151
5. ACE Power Embilipitiya Ltd.	23.61	0.42	8571.4285	21.1	0.99	20.889	179.0485	0.656511429	0.154999151
	100.00								**0.58442026**

4.2.5.6 Calculation of Combine Margin (CM) emission factor (average of approximate (OM) and build margin (BM)

Average operating margin emission factor (OM) = 0.702 kg/kWh (to be adjusted with lambda)
Average build margin emission factor (BM) = 0.584 kg/kWh

4. 3 National Baseline for small scale CDM projects in waste sector

AMS-III.D. - Methane recovery in agricultural and agro industrial activities

AMS-III.E - Avoidance of methane production from biomass decay through controlled combustion

AMS-III.F. - Avoidance of methane production from biomass decay through composting

AMS-III.G. - Landfill methane recovery

AMS-III.H. - Methane recovery in wastewater treatment

---- To be done by Dr. Wijekoon

4.4 National Baseline for small scale CDM projects in transport sector

AMS-III.B. - Switching fossil fuels

AMS-III.C. - Emission reductions by low-greenhouse gas emitting vehicles

---- To be done by Dr. Wijekoon

4.5 National Baseline for small scale CDM projects in industry sector

AMS-II.D - Energy efficiency and fuel switching measures for industrial facilities

---- To be done by Dr. Wijekoon

4.6 National Baseline for small scale CDM projects in Forestry sector

To be done by Dr. Nissanak

4.7 National Baseline for small scale forestry CDM project

To be done by Dr. Nisanaka

4.8 National Baseline for reforestation of degraded land

To be done by Dr. Nissanka

CHAPTER 5 - OVER ALL SRI LANKAN CDM OPPORTUNITIES AND POTENTIAL

- Analysis of sectoral GHG emission reduction potential i.e power, renewable energy, energy efficiency, forest and land use, transportation)
- Current Issues and constraints and competitive advantages and disadvantages each sector

5.1 National Potential of CDM

The developmental sectors that emit most of CO_2 include industrial, power, transport, and agriculture sectors. Potential CDM projects that can lead to emission trading can be projects that involve CO_2 emission avoidance and those with emission sinks. Therefore the Forestry sector and Power sector, agriculture, waste, and transport sector were identified as the potential sectors in Sri Lanka for carbon emission trading. In general energy sector has been identified as key sector for CDM projects in Sri Lanka. Projected electricity demand in 2010 - 18800 GWh and additional energy requirement is13200 GWh . Some of these energy may be produced as CDM projects. The studies suggest that the abatement cost of green house gas under CDM projects in Sri Lanka is very high in case of solar and wind options as green house gas abatement alternatives, so that they are not viable as CDM projects (Batagoda et al. 1999). However other renewable energy options such as hydro, and biomass power projects are viable as CDM project.

The country's existing 1.7 million hectares of scrub and haena lands in the country can be used for reforestation or energy plantations as CDM project. The study revealed (Batagoda et al. 1999) that if 10% of the available open land area is reforested as CDM projects, Sri Lanka can earn Rs. 5740 per tonn of carbon.

In the field of Energy, the report prepared by Nexus for the Ministry of Power and Energy in April 2004 (see Appendix 8 for an extract) summarizes the scope for renewable energy in Sri Lanka. Table 22 provides a summary of the potential for CDM projects by sector, described in the following sections.

Table 22 -Summary of National CDM Potential by Sector (Not Necessarily by 2012)

Sector	Annual Energy Reduction/Substitution potential/ year	Annual CO_2 Reduction Potential tonnes CO_2/year
Hydro Power	250 MW (35% p.f.)	613,200 tCO_2/y
Wind	480 MW (20% p.f.)	672,768 tCO_2/y

Solar PV	0		0
Biomass (Grid Power)	300 MW	(80% p.f.)	1,680,000 tCO_2/y
Biomass (Industrial Heat)	162 toe		512,000 tCO_2/y
Biomass (Absorption Refrigeration)	100 MW	(60% p.f.)	400,000 tCO_2/y
Energy Conservation: Electricity (Industry)	20,400 toe		64,700 tCO_2/y
Energy Conservation: Petroleum (Industry)	36,000 toe		113,800 tCO_2/y
Transport	206,000 toe		600,000 tCO_2/y
Agro Residue-Rice Husk	20 MW	(80% p.f.)	112,000 tCO_2/y
Agro Residue-Sawdust	20 MW	(80% p.f.)	112,000 tCO_2/y
Municipal Solid Waste			
Forestry	52,000 ha		1,352,000 tCO_2/y

Note: p.f. (plant factor). Total number of hours in a year is 8760 hours; therefore if a 1 kW plant operates on 100% p.f. it would generate 8760 kWh. If it operates at x% it would generate x% of 8760 for each kW of capacity.

5.2 Hydro Power (Mini and Micro-hydro)

The Ceylon Electricity Board considers all hydro power projects above 10 MW as Conventional Hydro Power (large hydro). All such projects, including the Upper Kotmale Project, totalling 411 MW in capacity and with annual average energy potential of 1434 GWh/y have been included in the Long Term Generation Plan 2005-2019 prepared by the CEB in November 2004. Conventional Hydro Power plants, being part of the National Baseline Generation Plan and being financially viable on their own without any additional financial inputs, do not qualify for CDM benefits due to "additionality".

The Upper Kotmale project could fulfil the "additionality" condition due to the fact that it took many years to finalize the project due to concerns raised by stakeholders in the vicinity of the power project. In fact, some groups are still protesting and attempting to prevent the start of the project. A CDM project for this power project could be formulated on the condition that the bulk of the CDM monetary benefits are used to socially develop the stakeholders living in the vicinity of the project.

The total mini hydro potential (grid-connected power plants with capacities less than 10 MW) is estimated as 300 MW. Around 70 MW are already commissioned. Only about 30 MW have completed CDM projects. Thus, effectively 250 MW of potential is available for CDM in this respect.

In respect of micro hydro, (also known as "village hydro") usually less than 1 MW, but always of the off-grid type, the potential in Sri Lanka has been estimated as nearly 200 MW. These projects are all too small and even the outputs are not metered. The village community benefiting from these projects is charged according to the installed load in each household. Due to the low generation capacity such projects would need to be bundled to qualify for CDM. However, practical problems with bundling many such diversely located projects, and the difficulty in monitoring their performance makes it unlikely that they would qualify for CDM.

5.3 Wind and Solar Power

According to the study done by the National Renewable Energy Laboratory (NERL) USA, the total potential under the category "Good & Excellent" condition with over 7 m/s wind amounting to 24,000 MW is available in "on shore". In view of the high foreign cost and low annual plant factor only a tiny fraction of this would be developed in the foreseeable future. Only about 480 MW (2% of total potential) has the potential to be developed.

There is already a 3 MW wind power project, with 6 wind mills each of 500 kW, located in the southern part of Sri Lanka commissioned and operating for the past few years. This project was implemented by the Ceylon Electricity Board with part funding from the Global Environmental Facility. The capital cost at the time of commissioning was around US$ 1200 per kW. The overall performance of this facility has been very disappointing. The annual units generated by this 3 MW facility have been around 3 GWh per year. This amounts to an annual plant factor (p.f.) of 11%. In neighbouring India, the average annual plant factor (p.f.) of wind mills is around 20%, and in Europe this is over 30%.

The following reasons are attributed to the poor performance of this facility:

- This facility is located near the end of a long distribution network. Due to many natural causes, very frequently this power line gets cut-off from the grid. During such times, the wind generating system cannot export the power generated. Moreover, as the line is very long, depending on the variations in the load connected to this line, the voltage level at the point of interconnection varies very widely. As the wind mills do not have the capability to accommodate such variations, the interconnection gets disconnected very frequently.
- The actual location of this wind power facility is different to the site identified by the CEB. This change of location was brought about by environmental groups, on the ground that this power plant would be located in the path of migratory birds.

From the point of view of wind availability, the change of location has resulted in lower power output.

For solar power, towards the end of 2004, over 63,000 Solar Home Systems with capacities varying from 30 watts to 100 watts have been installed in Sri Lanka. The total capacity of these projects amounts to 3 MW. These projects cover the whole of Sri Lanka. These projects are installed by around 6 Solar Power Private Sector Companies. It is not practical to bundle such a large number of small projects installed in many different locations, owned by different private sector companies. More over, due to the high transaction costs of CDM projects, usually projects with capacities less than 30,000 tonnes of CO_2 per year of emission reductions are not considered. The cumulative capacity of the solar power panels installed in Sri Lanka up to date amounts to 3 MW. The emission reductions achieved by these solar panels amount to 4,000 tonnes of CO_2 per year. This is far short of the 30,000 tonnes per year cut-off limit. Hence solar power projects in Sri Lanka have a minimal opportunity in qualifying for practical CDM projects.

5.4 Biomass

The potential and economic viability for sustainable biomass production and conversion to energy in Sri Lanka are very good. Around 40% of the total land area amounting to 2.4 million hectares is under utilized. (Sessional Paper No. III-1990: Report of the Land Commission – 1987). More over, even traditional crops such as coconut, tea etc. also have intercropping potentials for sustainable energy plantations. For electricity generation purposes, as an initial estimate a total of 100 MW is expected by the year 2010 (Report of the Inter-Ministerial Working Committee on Dendro Thermal Technology, June 2005). A further 200 MW could be expected for the year 2012. Unlike hydro or wind projects, biomass power projects are flexible with regards to location and size of the power plants. The resource for biomass power plants, the biomass fuel supply, can be transported within reasonable distances to power plants. This enables the developer to choose the location and capacity of the power plant based on a number of alternative criteria. Unlike hydro power projects, there are no predefined names or capacities for biomass power plants. Three applications where biomass fuel may be used as an alternate energy source are discussed briefly below.

5.4 1. Industrial Heat

The opportunity exists for the replacement of fossil fuel with biomass fuel for industrial thermal applications. In the short term, approximately 162 toe of fossil fuel may be replaced with sustainable biomass. This would amount to an abatement of 512,000 tCO_2 per year. This topic is further discussed in the following section.

5.4.2 Absorption Refrigeration

Biomass fuel could also be used to replace electrically driven vapour compression based refrigeration and air-conditioning systems to steam driven vapour absorption systems. Ice manufacturing plants, large hotels and large commercial buildings could adopt this system. The initial cost of replacing the electrical driven machinery to steam driven machinery is very high. However, the operating costs are very much lower. Lack of project capital at affordable financing cost is the primary reason for the failure to adopt this technology. It is difficult to provide an accurate assessment of the national potential for biomass fuel in absorption refrigeration. As an initial target, approximately 100 MW of electrical power at a plant factor of 60% could be replaced with a biomass fuelled steam system. The potential for GHG emission reduction is estimated as 400,000 tonnes CO_2 per year.

5.4 4. Household Sector

Although over 80% of the households use biomass as the cooking fuel, almost all of this biomass fuel comes from renewable sources such as home garden, agro residues, or rubber and cinnamon plantations. Hence any efficiency improvements carried out in this sector would not have any impact on the GHG emission level. However, due to urbanisation and improvement in the standard of living among the population, there is a tendency among the population to switch from biomass fuel to LPG (liquid petroleum gas) as the cooking fuel. The price of LPG has been increasing steadily in the last decade, much faster than the rise in prices of other petroleum fuels. To some extent, this sharp increase in the price of LPG has helped reduce the number of customers switching from fuel-wood to LPG.

An attempt is being made in the country to provide a cheaper alternative to LPG. A new stove developed by the National Engineering Research and Development Centre (NERDC) has to some extent fulfilled this need. It is reported that around 200 such stoves are being marketed daily by a private sector manufacturer (Spectra Industries, Kurunegala). Application of this process as a CDM project is not practical from the point of view of bundling, monitoring and verification. Hence this option is not included in this report.

5.5 Energy Efficiency

Energy efficiency in all business sectors in Sri Lanka is very low and therefore government assistance to invest on efficiency improvement and modernization is important to face the energy crisis (Jayatissa, 2006). Conventional energy inefficient systems are still widely used in Sri Lankan industry. It is timely that these systems are restructured to use technologically advanced energy efficient systems. Some of the areas that could be developed include:

- **Reduction of transmission losses of power**:
  Losses due to transmission inefficiencies are estimated to be significantly high. This translates to higher energy tariffs to the consumer as well as calls for the use of additional sources of energy to supplement the losses.

- **Introduction of energy efficient systems for industry:**
  Industry, including the plantation industry uses a significant number of highly energy inefficient production systems. This situation brings about higher cost of production and which translates into reduction of social benefits in terms of benefits for the workers and the economy as a whole. Investment on energy efficiency improvements have a very short payback period. For example, a tea factory which spent Rs 450,000 – 500,000 on fuel and electricity per month reduced its energy bill by around Rs 100,000 after improving its energy efficiency. The pay back period was one year for the investment of Rs 1 million (Jayatissa 2006).

- **Water supply schemes:**
  Conventional water pumping mechanisms used by the water supply systems could be transformed into energy efficient systems using newer technology.

- **Conventional building technology:**
  The conventional buildings in Sri Lanka use very high amounts of energy due to their energy inefficient architecture. The Green building technology standards should be adopted in the future buildings (making use of natural sunlight and ventilation and environmental friendly). It is also important to maximize the energy efficiency in the older buildings.

- **Energy saving bulbs:**
  The vast majority of the households consume electricity for lighting applications. The national average consumption of electricity for the household sector alone is 900 kWh per household per year. The introduction of Compact Fluorescent Lamps (CFL) has reduced the consumption slightly. Due to the extremely low electricity tariff applicable for the low-end households and the relatively high prices of CFL have been the reasons for the slow progress in this programme. The impracticality of bundling such large number of households and to monitor their performances and certifying the actual GHG reductions makes this option not feasible as a CDM project.

The energy efficiency aspect in the transport and industrial sector are discussed in the respective sections.

5.6 Industry

The annual consumption of electricity and petroleum in the year 2003 by the industrial sector amounted to 204,000 and 360,000 tonnes of Petroleum Equivalent respectively.

These figures are increasing annually at a rate of 6% and 5% respectively. In addition the industrial sector also consumes approximately 1,236,000 Tonnes of Petroleum Equivalent of bio fuels annually. As most of the bio fuels are from renewable resources such as rubber plantations or dedicated woodlots, any reduction in the consumption of bio fuels would not result in CO_2 emission reductions. Hence bio fuels consumption by the industrial sector is not considered for CDM application.

Emission reduction of GHG in the industrial sector could be achieved by two different approaches: (a) Efficiency improvements to reduce consumption and (b) Substituting fossil with sustainable biomass fuels.

5.6.1 Efficiency Improvements

Energy conservation and efficiency improvement is pursued by two independent Government organizations and a professional association in Sri Lanka. The Government organizations are the Energy Conservations Fund (ECF) under the Ministry of Power and Energy and the National Engineering Research and Development Centre under the Ministry of Science and Technology. The professional association promoting energy conservation is the Sri Lanka Energy Managers Association.

Although many options to reduce energy consumption have been identified, very little progress towards energy conservation has been achieved due to the high initial capital cost needed to implement these proposals, and the prevailing high interest rates in the commercial banking sector. To resolve this issue the Government has introduced a fund called Energy Conservation Guarantee Fund (ECGF). Under this scheme, an energy conservation project evaluated and recommended by the ECF could utilize the ECGF as collateral to obtain a loan at a lower interest rate to implement the proposal.

The industrial sector could make use of the CDM opportunity to enhance the financial benefits from such energy conservation activities. A 10% reduction in both petroleum and electricity consumption would result in a GHG emission reduction of 64,700 tonnes of CO_2 reduction for electricity consumption and 113,800 tonnes of CO_2 reductions for petroleum consumption.

5.6.2 Substitution of Fossil Fuels by Fuel-wood

Petroleum fuels consumed by the industrial sector are utilized entirely for industrial heat applications. These could be replaced by sustainable fuel-wood from dedicated energy plantations. In fact one industry has already implemented a scheme to replace part of the furnace oil consumed for industrial drying with sustainable fuel-wood. In order to implement this proposal the industry concerned could introduce a biomass gasifier to convert fuel-wood into a combustible gas and use this gas in the equipment (furnace or boiler) that earlier consumed petroleum fuels or replace the equipment (furnace or boiler) with one suitable for fuel-wood directly. The former option is lower in capital cost but

cannot be implemented in all situations. The second option is applicable to all cases, but has a much higher capital cost. Moreover, switching from petroleum fuels to fuel-wood may not be feasible in congested urban locations.

From a technical and economical point of view almost all the heat energy requirement of the industrial sector could be met from renewable resources, particularly by the use of bio fuels. The only exceptions are applications where electrical heating is the only option due to hygienic conditions. At the prevailing costs of fossil fuels and fuel-wood from sustainable energy plantations, on an energy equivalent basis, fuel-wood costs one fourth to one seventh the cost of fossil fuel (depending on which fuel- furnace oil, diesel or LPG is used).

Assuming 10% of the present fossil fuel consumed by the industrial sector is reduced by energy conservation measures, and 50% of the balance is replaced by bio fuels, the potential for GHG emission reduction amounts to 512,000 tonnes of CO_2. One practical difficulty anticipated in this venture is the task of bundling the many small scale industrial applications. The DNA should address this issue.

Thus, the CDM potential for industry is significant. The projects that can be adopted include:

- Fuel switching projects
- Increasing energy efficiency (refer section 5.1.4)
- Use of green building technology

5.7 Transport

According to the Energy Balance 2003 provided by the Energy Conservation Fund the transport sector consumed 2,060,000 tonnes of petroleum fuels in 2003. This is growing at around 8% per annum. Emissions from the above quantities of fuels amount to 6.5 million tonnes of CO_2 per year. If this could be reduced by 10%, 600,000 tonnes of CO_2 reductions could be sold as CERs.

In dealing with CDM activities in the transport sector, we need to recognize the difficulty in bundling a large number of users in the transport sector. One option is to focus on few selected large users such as the railway sector. Policy CDM also provides an opportunity in this sector. CDM project activities in the transport sector could arise from the following three approaches: (a) Policy initiatives to change transport modes; (b) Introduction of energy efficiency improvements to the transport fleets; (c) Switching from fossil fuels to sustainable bio fuels, which are carbon neutral. These issues are discussed below.

5.7.1 Policy Initiatives to Change Transport Modes

At present a substantial number of travellers use individual motor cars. This mode of travel is very costly, utilizes fuel very inefficiently and causes traffic congestion on roads thereby reducing the efficiency of other modes of transport such as travel via bus. Switching the mode of transport from car to bus would bring substantial benefits particularly in the form of better fuel efficiency. However, the quality of the public transport system in Sri Lanka would need to be improved significantly to convince commuters who travel by car to ride the bus.

In respect of transport of goods, only a small percentage of the goods are transported by rail. A bulk of the goods is transported by road. Transporting goods by road is very inefficient from a fuel utilization perspective. Switching from road transport of goods to rail transport would result in less fuel consumption.

5.7.2 Enhancing Energy Efficiency in Transport Fleets

A large section of the buses purchased in Sri Lanka have been used previously in other countries. The engines and transmission systems of these vehicles are very inefficient and thus consume more fuels and cause increased pollution. The efficiencies of these systems could be improved by proper maintenance and replacement of engines where necessary.

A large number of 2-stroke engine based motor cycles, and three-wheelers are in operation in Sri Lanka. This type of engine consumes more fuel and emits more pollution particularly in the form of un-burnt hydrocarbons. The operation of such 2-stroke engines is no longer permitted by law in many countries. Similar legal measures are necessary to be introduced to gradually phase out 2-stroke engines and introduce 4-stroke engines. Such measures would result in lesser fuel consumption and lead to better air quality.

5.7.3 Production and Use of Alternate Fuels such as Bio Fuels

Use of bio fuels as substitutes for fossil fuels would result in substantial emission reductions. Bio diesel (treated vegetable oil), bio ethanol (ethyl alcohol) and bio methane (from anaerobic digestion of perishable biomass) are being used in varying extent in many countries as substitutes for fossil fuels in transport application. These exercises are carried out not for economical reasons but as strategies to ensure energy security and for environmental considerations.

In Sri Lanka, all three options of bio diesel, bio ethanol and bio methane could be applied in varying extent. Bio diesel and bio ethanol production would compete for land for food and solid fuel production. On the other hand the vast amount of agro residues such as straw, animal dung, perishable municipal wastes etc. could be deployed to generate bio

methane and utilized as fuel for the transport sector. The bio residues produced annually in the country could generate 3200 cubic meter of biogas equivalent to 1.6 million tonnes of diesel. This is nearly 75% of our national fossil fuel used in the transport sector. As mentioned earlier, Sri Lanka could target a 10% reduction of the transport sector emissions, which amounts to approximately 600,000 tonnes of CO_2 emission reductions under CDM.

The Ministry of Science and Technology is carrying trials on yield determination on Jatropha, an oil producing crop. This Ministry is also examining the demonstration of utilizing bio methane from municipal waste disposal as transport fuel.

5.8 Agriculture

The agricultural sector in Sri Lanka is an important sector as far as climate change is concerned for many reasons. Any change in the climate would directly affect the agricultural output. More over, in the event of a rise in sea level, agricultural lands near the coastal areas would be adversely affected. As far as GHG emissions are concerned, rice cultivation under flooded condition emits substantial quantities of methane, a potent GHG. The agricultural sector is also susceptible for land use changes, particularly in the dry zone, where large extent of forest lands have been converted into scrub land by slash and burn shifting cultivators.

In terms of energy consumption, the contribution from the agriculture sector is insignificant in Sri Lanka. There is not much scope for fuel switching or energy conservation. However, the possibility exists to reduce methane emissions from rice fields, through better water utilization. Further research is required to realise better water utilization techniques in paddy cultivation in Sri Lanka.

The carbon sequestration potential in the agricultural sector may be enhanced by encouraging energy plantations such as Gliricidia in the marginal plantation lands, scrubland and also planting it as an intercrop.

5.9 Waste Disposal

Two major types of waste are generated in Sri Lanka. The first category generated by the agro-industrial sector, essentially consists of rice husk, rice straw and saw dust. The second type of waste is from the household wastes generated mostly from the urban sector. Most of the surplus rice husk are dumped into water bodies or are incinerated in open piles. Similarly, most of the surplus rice straw is incinerated in the rice fields. Saw dust generated in saw mills located in selected areas are dumped into water bodies. Municipal waste disposal poses a huge problem to all local bodies in Sri Lanka.

5.9.1 Agro-Residues

Surplus quantities of rice husk produced in the country amounting to 160,000 tonnes per annum could be used to generate electrical energy with an output of 20 MW or 140 GWh/year. This would lead to a GHG emission reduction of 112,000 tonnes of CO_2 per year. The projects would generally have capacities of 5 MW and therefore would qualify for CDM by themselves.

The total quantity of saw dust generated also amounts to around 160,000 tonnes per annum. This too could be used for electricity generation, generating 20 MW of power with an annual energy of 140 GWh/year. A GHG emission reduction of 112,000 tonnes of CO_2 could be achieved under CDM projects.

Rice husk and saw dust could also be converted into briquettes for urban household cooking. As far as GHG emission reduction potentials are concerned household cooking or electricity generation would not make any difference.

5.9.2 Municipal Solid Waste

The average quantity of municipal solid waste generated is estimated to be 0.5 kg/person/day. The total tonnage of municipal waste generated in Sri Lanka is estimated as 2,838 tonnes per annum. Direct burning of municipal garbage is not appropriate for two reasons. Firstly the moisture content of garbage as received is very high, resulting in very little net energy out put. Secondly, some of material in the waste such as plastics and nitrogenous materials are not suitable for combustion. The average composition of Sri Lankan municipal garbage is as follows:

Combustibles (wood etc.):	25%
Organic (vegetable wastes, leaves etc.):	59%

Attempts made to dispose municipal garbage in sanitary land fills have not materialised due to failure to identify suitable land fill sites which could be acceptable to the surrounding communities. A project has been initiated to utilize the Colombo garbage to extract methane and to utilize it to generate electricity to be sold to the national grid. Garbage landfills emit methane and carbon dioxide by the anaerobic decomposition of organic materials, and contribute to GHG in the atmosphere. By inserting pipes of appropriate sizes at appropriate locations in the garbage pile, it is possible to capture these gases and utilize it to generate electricity and feed it to the national grid. The initiated project has a capacity of 244,000 tonnes of CO_2 emission reduction per annum.

5.10 Forestry

A study on CDM sink projects, revealed that if 10% of the available open land area of Sri Lanka is reforested as CDM projects, Sri Lanka has the potential to earn approximately Rs 4,100 - 10,700 million per year (market price for 1 tonne carbon sequestered was considered as $ 90 in this study) within the next 10 years. The profits per tonne of carbon sunk through CDM reforestation projects was estimated as Rs 5740 (Batagoda 2000). However, it should be noted that the current market value of CERs range from $5 - $15.

Sri Lanka's Deputy Conservator General of Forest, Mr. L. Ariyadasa believes that the forestry sector could play a vital role in CDM projects as carbon sinks. In Sri Lanka, the Forest Department is a state institution entrusted with the task of conserving the natural forests as one of its primary objectives. This department is also entrusted with the task of establishing and maintaining commercial forest plantations to meet a part of the national timber requirements. Extraction of timber from such commercial forest plantations is entrusted to the State Timber Corporation, another state institution. The Forestry Sector Master Plan developed in 1990 stipulates that natural forests would not be deployed to meet timber requirements; consequently all natural forests in Sri Lanka are preserved in tact without any extraction.

The Forest Department plans to establish around 1000 ha of commercial plantations annually, including any land handed back to the Forest Department by the State Timber Corporation after timber extraction. According to the Deputy Conservator General of Forest the activities of the Forest Department in respect of forest plantations would not qualify for CDM projects for two reasons: (a) part of Forest Department's base-line activity, and would be disqualified from the point of view of "additionality; (b) prior to establishing plantations, these lands are cleared of all existing tree covers, either by the State Timber Corporation for extraction of commercial timber or by other contractors of Forest Department.

Although, the activities of the Forest Department may not qualify for CDM, the activities of private developers and other state institutions would qualify for CDM. Two such projects which are in the pipelines are listed below:

1) Expansion of Rubber Cultivation into Marginally Dry Region (Monaragala).
- Land area: 4000ha
- Project start date: 2006
- Expected CER delivery - 1st year: 106,000 tCO_2 - up to 2012: 640,000 tCO_2
- Baseline scenario: exclude C fixing by covers – 86t
- Additionality: no tree crops, only grasses and bushes

2) Planting Rubber in Marginal Tea Lands
- Land area: 5000ha
- Project start date: 2007
- Expected CER delivery - 1st year: 90,750 tCO_2 - up to 2012: 453,750 tCO_2
- Baseline scenario: exclude C fixing by tea

- Additionality: introduce into existing tea lands

According to a recent survey, at least 38,000 hectares of land in the dry zone are available for reforestation, while 14,000 hectares are available in the hill country. Based on the above, and on an estimate of 26 tonnes of CO_2 sequestration per ha/year, the national CDM potential for other projects of this nature is estimated as 1,352,000 tonnes CO_2 per year.

5.11 The potential state sector CDM projects

5.11.1. Replacing old refineries

Refineries of the Ceylon Petroleum Board are outdated and as a result they are inefficient. Though there is a need for the replacement of these old refineries, due to financial, economic and political situation of the country there is no possibility to replace these old refineries with new efficient refineries. However, there is a possibility to replace these old refineries under the CDM project activity if CDM revenue can meet a percentage of total investment. According to past experience, CDM projects can provide up to 20% of the total investment depending on the total volume of GHG saved. At this point it is difficult to estimate the total CDM revenues that can be earned from replacing old refineries with new technologies.

Baseline emissions for this project are the GHG emissions emitted from the old refinery (old technology) including any fugitive emissions. The difference between the emissions from old refinery and emissions from new technology can be estimated as carbon credits. Further analysis is required to estimate the total carbon trading potential of this project.

The important factor here is that we should be able to prove or demonstrate that if there is no CDM money this project will not happen and we will continue to use the old refineries. Therefore in the government decision to replace these old refineries there should be a reference that the project will be implemented as a CDM project. This is important to demonstrate that under business as usual scenario this project will not be implemented and only under CDM project activities the government is planning to undertake this project.

For this project new methodology has to be approved by the CDM executive board so that it takes around one year to complete the CDM project development process. This also depends on how fast the actual implementation can be taken place.

5.11 2. Replacing outdated bus fleet of Ceylon Transport Board

The Ceylon Transport Board has many fleets, numbering over 8900 buses that are fuel hungry. These buses consume considerably higher volume of fuel than new buses. Due to economic and financial situation of the Ceylon Transport Board and the country it is unlikely that these old fleet is replaced with new fleet in the near future. The business as usual scenario is that the Ceylon Transport Board continues to use this old fleet owing to the financial and economic situation of the organization. However, there is a possibility to replace this old fleet under the CDM project activity if CDM revenue can meet a percentage of total cost of the project. At this point it is difficult to estimate the total CDM revenues that can be earned from replacing old fleet with a new fleet.

Baseline emissions for this project are the carbon dioxide (CO_2) emitted from the old fleets. The difference between the emissions from old fleet and emissions from new fleet can be estimated as carbon credits under CDM. Further analysis is needed to estimate the total potential of this project.

The important factor here is that we should be able to prove or demonstrate that if there is no CDM money this project will not happen and we will continue to use the old bus fleet with minimum repairs even through it emit higher emissions. Therefore in any government decision to replace this old fleet there should be a reference that the project will be implemented only as a CDM project. This is important to demonstrate that under business as usual scenario this project will not be implemented and only under CDM project activities the government is planning to undertake this project. This is because the business as usual projects are not eligible as CDM projects.

For this project, CDM project development process will take around 6 months. This also depends on how fast the project can be implemented.

5.11.3. Improvement of Sri Lanka Railway replacing old engines and possibly introducing electric trains

Sri Lanka Railway has very old diesel engines that pollute the environment. There is a lot of potential to improve the train service by putting new trains and adding new railway lines which attract new commuters to railway. There is a potential to increase commuters by 200,000 a day and increase to over a 1.4 million per day in few years. This will reduce great deal of CO_2 emission through fuel saving. However due to various technical, financial and economic barriers this project is not possible in the near future. These barriers can be removed through developing this project as a CDM project since the CDM revenue can meet part of the investment costs.

The difference between the emissions due to present railway system and emissions from the improved railway system which can be estimated as carbon credits under CDM. The total revenue from the sales of carbon can be estimated after project components are decided.

In order to implement this project as a CDM project we should be able to prove or demonstrate that if there is no CDM money this project will not happen and we will continue to maintain the existing railway system even though it has higher emissions. Therefore in any government decision to improve the railway system introducing electric trains there should be a reference to CDM that the project will be implemented only as a CDM project. This is important to demonstrate that under business as usual scenario this project will not be implemented and only under CDM project activities the government is planning to undertake this project.

CDM project development process will take around 6 months. This also depends on how fast the project can be implemented.

5.11. 4. Cleaning the Sri Lanka Power system - Ceylon Electricity Board

Sri Lanka has a large CDM potential in the power sector. Some of these old diesel and fuel oil plants can be converted to combined cycle plants (the CEB officials can decide on which plants to replace). The proposed 900 MW of coal power plant could be converted to more advanced coal processing technologies with clean coal. Proposed new gas power plants can be developed as CDM project. Even Upper Kotmale Hydro Power Project can be converted to a CDM project through interpretation of CDM rules for our benefits and getting further clarifications from Executive Board. There are some barriers for this. There is some room for manipulation and to make the Upper Kotmale a CDM project. However, these projects should be evaluated case by case for their CDM eligibility.

If the government gives its priority, this is the largest CDM sector in the country.

5.11.5. Introducing nationwide CFL bulb system - Ceylon Electricity Board

The Ceylon Electricity Board has been promoting the use of CFL bulbs in residential and commercial premises many years on a voluntary basis. CFL bulbs consumes considerably lower amount of energy than normal incandescent bulbs so that this will GHG emissions. With the government intervention a nationwide CFL bulb introduction program can be undertaken as a CDM project.

The total CDM revenue and potential is dependent upon the how past this project can be implemented.

In order to implement this project as a CDM project we should be able to prove or demonstrate that this project will be possible only if CDM funds are made vaialble otherwise the business as usual scenario will continue.

5.11. 6. Reduction of transmission loss - Ceylon Electricity Board

Sri Lanka power system experience around 17% transmission loss. This can be reduced considerably through technical and management interventions. Through proper designing, Sri Lanka electricity transmission loss reduction project can be undertaken as a CDM project. The total potential of CDM earning depends on the total possible reduction of transmission loss.

5.11.7. Improvement of efficiency of industrial process

Some state owned industries such as Paper Company still use old boilers and other equipment in the production process. These old industries can be replaced with new energy efficient technologies under CDM project activities. The total number of possible industries that can be converted and their total CDM potential need to be estimated.

5.11. 8. Introducing water pumping efficiency improvement - NWSDB

National Water Supply and Drainage Board consumes a considerable amount of energy for pumping water. Introducing efficient system the WSDB can save energy. Through implementing this project as a CDM project the country can earn foreign exchange by selling carbon credits. The total foreign exchange earning potential can be estimated after consultation with WSDB officials.

5.11. 9. Bus Rapid Transit (BRT) Project

Bus Rapid Transit (BRT) is a bus based mass transit system that delivers past comfortable and cost effective urban mobility. The Urban Development Authority (UDA) has initiated a BRT project starting from Dematogoda to Battaramulla to reduce traffic congestion to Battaramulla from various places introducing new dedicated bus line alone the Dutch canal.

This BRT will reduce green house gas emissions via:

- Improved fuel use efficiency through new and large buses
- Mode switching due to availability of a more efficient and attractive public transport system
- Load increase by centrally managed organization dispatching vehicles
- Potential fuel switch to low carbon emissions

BRT system replaces the conventional public transport system. The new bus system transport passengers, who in the absence of the project would have used the conventional public transport system or other modes of transport such as passenger cars. As a part of the project a reduction or retirement of some of the conventional buses through scraping and reduction of route permit could be taken place, which reduce green house gas emissions.

The estimation of the total carbon credit earning potential of this project needs more detail information.

5.11.10. Reforestation and afforestation projects in Sate lands

There is a potential for forest plantation in the marginal areas of the JEDB, SPC, NLDBW and other state own coconut, rubber and tea estates including pasture lands. This degraded or abandoned land can be reforested as CDM projects and earn carbon credits. Forest Department can undertake forestry projects as CDM projects.

Estimation of total potential needs further analysis with detail project information.

5.12 Limitations

a) The first commitment period for CDM is between 2008 and 2012. Therefore we have only a few years left to develop CDM projects. All of the above identified CDM projects require at least 3 year lead time. This means that during the first commitment period, these projects can earn credits only for a few years. However, there is a strong possibility to extend this period and have a second commitment period. We must prepare for the second commitment period as well.

b) Lead time for a large CDM project is around 3 – 5 years.

c) The other issue is that the business as usual projects are not eligible for CDM. In other words, if a project can happen under the business as usual scenario without the CDM benefits, that project is not eligible for CDM. The government should indicate some where in policy decisions that these projects will be implemented as CDM projects since given the financial situation these projects will not be undertaken under the business as usual scenario.

d) This needs government commitment

e) The CDM project development cost is very high and it ranges from Rs. 3 million to Rs. 20 million.

CHAPTER 6 - PROJECT PIPE LINE AND FORT FOLIOS

- Preparation of a strategic project pipeline with time target for project proponents to access carbon finance
- Develop separate strategy for Large scale projects and small scale project
- Prioritized the project pipe line according to the implementation plan

6.1 Projects Applicable for CDM by Priority Sector

Table 23 Project pipeline and portfolio

ID	Project title	country	Scope	Gas	emissions reductions/minimum price 2005-2007	2008-2012	Project Developer/contact
			one of 15 possible*		#,###,### t CO2e #.## EUR/t	#,###,### t CO2e #.## EUR/t	
1	Aqua Power (Pvt) Ltd - Labuwawa Mini Hydropower project (PIN)	Sri Lanka	2MW Hydropower Plant	CO2	total of 9,930 t CO2e for 2 years/ price negotiable	total of 24,825 t CO2e for 5 years/ price negotiable	M.H.N.M.De Silva 0115-333800 aquapower@sltnet.lk
2	Tokyo Cement Biomass Power Project Trincomalee (PIN)	Sri Lanka	6.6 MW Biomass Power Plant	CO2	total of 49,807 t CO2e for 1 year/ price negtiable	total of 249,035 t CO2e for 5 years/ price negotiable	U Vyravanathan Tele: 94-11- 2500466 tokyogm@sltnet.lk www.tokyocement.lk
3	SJL Holdings (Pvt) Ltd. (PIN)	Sri Lanka	12.25 MW hydro power plant	CO2	total of 2607 t CO2e for 1 year/ price negotiable	total of 201,863 t CO2e for 6 years/ price negotiable	Mr. J.A.I.P. de Seram Tel: 0094 (0) 81 2226051 sjlholdings@sjlgroup.net
4	Coconut shell carbonising gas based power Generation (PIN)	Sri Lanka	8 MW Biomass Power Plant	CO2, CH4, N2O, CO	total of 80,000 t CO2e for 1 year/ price negotiable	total of 1,000,000 t CO2e for 12 years/ price negotiable	Mr. L P Jayasinghe + 94 11 4723847 Fax + 94 11 26996 lpj@haycarb.com & www.haycarb.co
5	Rubber cultivation for sustainable development forestry (PIN)	Sri Lanka	20,000 ha of forestry	CO2	total of 53,166 t CO2e for 1 year/ price negotiable	total of 318,996 t CO2e for 6 years/ price negotiable	V.H.L. Rodrigo Tel:0094-(0)34-47426 Fax:0094-(0)3 47427 aksh@sltnet.lk
6	Assupiniella Small Hydro Power Project (PIN)	Sri Lanka	4 MW hydro power	CO2	total of 15,462 t CO2e for 1 year/ price negotiable	total of 92,772 t CO2e for 6 years/	Anura Wijayapala Tel:0094 (0) 112 684900 anura@ltl.lk

			plant			price negotiable	
7	Vanasaviya Biodiesel production (PIN)	Sri Lanka	40,000 ha Jatropha cultivation	CO2	total of 400,000 t CO2e for 2 years/ price negotiable	total of 1,400,000 t CO2e for 7 years/ price negotiable	Don Mahinda Panapitiya Tel:94-66-2284803 davids@sltnet.lk
8	1MW Biomass Power Plant in Walapane (PDD)	Sri Lanka	1	CO2	total of 12,040 t CO_2 for 2 years / price negotiable	total of 30,100 t CO_2 for 5 years / price negotiable	Lanka Transformers Ltd. / 67, Park S Colombo 02 / 94-11-2695007 / udj@
9	Biomass Power Project at Amapara (PIN)	Sri Lanka	15 MW Biomass Power Plant	CO2	total of 90,000 t CO2e for 1 year/ price negotiable	total of 540,000 t CO2e for 6 years/ price negotiable	Dr.Wimal Wimaladasa TeL / Fax: 00 – 94 - 81-2200947 beckie@ispkandyan.lk
10	SJL Minihydro (Pvt) Ltd.(PIN)	Sri Lanka	9 MW hydro power plant	CO2	None (First year of CER in 2009)	total of 88,396 t CO2e for 4 years/ price negotiable	Mr. J.A.I.P. de Seram Tel: 0094 (0) 81 2226051 sjlholdings@sjlgroup.net
11	1 MW Biomass Power Plant of Informatics Agrotech (PDD)	Sri Lanka	1,14	CO2	total of 6,020 t CO_2 for 1 years / price negotiable	total of 30,100 t CO_2 for 5 years / price negotiable	Infomatics (Pvt) Ltd., 104, Kithuwatta Colombo 08, Sri Lnaka / 94-11-5322 gamini@infomatics.lk
12	Delta, Halgran Oya, Sanquhar power project (PIN)	Sri Lanka	1	CO2	total of 20,358 t CO_2 for 2 years / price negotiable	total of 101,790 t CO_2 for 5 years / price negotiable	Eco-F Limited / 228 Havelock Road, Colombo 05, Sri Lanka / 0094(0)11 2584927
13	Adavikanda Small Hydro Power Project	Sri Lanka	6.5 MW hydro power plant	CO2	total of 20,616 t CO_2 for 1 year / price negotiable	total of 123,696 t CO_2 for 6 years / price negotiable	Mr. A.K. Dheerasinghe Tele: +94 -11 – 2381111 energy@vallibel.com
14	Barcaple Small Hydro Power Project	Sri Lanka	6.5 MW hydro power plant	CO2	total of 16,664 t CO_2 for 1 year / price negotiable	total of 99,984 t CO_2 for 6 years / price negotiable	Mr. A.K. Dheerasinghe Tele: +94 -11 – 2381111 energy@vallibel.com

15	Erathna Small Hydro Power Project	Sri Lanka	9.9 MW hydro power plant	CO2	total of 55,490 t CO_2 for 2 years / price negotiable	total of 194,215 t CO_2 for 7 years / price negotiable	Mr. A.K. Dheerasinghe Tele: +94 -11 – 2381111 energy@vallibel.com
16	Way Ganga Small Hydro Power Project	Sri Lanka	9.0 MW hydro power plant	CO2	total of 65,284 t CO_2 for 2 years / price negotiable	total of 228,494 t CO_2 for 7 years / price negotiable	Mr. A.K. Dheerasinghe Tele: +94 -11 – 2381111 energy@vallibel.com
17	Landfill Gas Energy Project	Sri Lanka		CH4	total of 29,400 t CO_2 for 2 years / price negotiable	total of 102,900 t CO_2 for 7 years / price negotiable	Mr. Ravi Wijeratna +94 11 2522222/ +94 11 2527246 betl@itmin.com
18	Kumburuteniwela Small Hydro Power Project	Sri Lanka	2.4 MW hydro power plant	CO2	total of 21,320 t CO_2 for 2 years / price negotiable	total of 74,620 t CO_2 for 7 years / price negotiable	Chrysanth Jesuthasan 0094 (0) 722 260190/ 11 4723995 powerconsult@sltnet.lk
19.	Bambarabatuoya minihydro	Ratnapura	3.2 MW	CO2		3917 year	Mr. Riyaz Sangani/Director, Vidul La (pvt.), N0. , Chelsea Gardens, Colon xaviern@power.lk, 011-4712594
		Ekala	56784 MWh	Co2	244000 tCO2 year		Mr. Oliver Ranasinghe, Director, Bio (pvt.) Ltd, 182/1A, 2nd Floor, Castle Colombo 8- orionint@eureka.lk - Tel 112868372/ 112381740
20.	Colombo organic waste plant Wind power plant	Puttalam	20MW	CO2	65000 tCO2 year		Mr. Noel Selvanayagam, President, Trade Combine Ltd., N0.3 R.A.De M Mawatha, Colombo 5, - noel@senok - Tele 112591991/ 112593343
21	Gatambe Mydro	Gatambe	12MW	CO2	42000 tCO2 year		Mr. Avanthi Jayatilake, EML Ltd. No. Davidson Road, Colombo 4 Tele- 115535880/ 112559109 e-mail - eml@sltnet.lk
22							

	Atambage small hydro	Ulapane	3MW	CO2	10500 tCO2 year	Mr. Avanthi Jayatilake, EML Ltd. No. Davidson Road, Colombo 4 Tele- 115535880/ 112559109 e-mail - eml@sltnet.lk
23						
24	Wind power plant	Puttalam	50MW	CO2	175,000 tCO2 year	Largerway Wind Turbine Internationa
	Biomass power	Walapane	6MW	CO2	30000 tCO2 year	Mr. Indika Gallge, Tele 112695007, indika@ltl.lk
25						
	Lion Brewery Ltd.	Biyagama			1656000 t CO2 year	Dr. K. Knagachnadran, Lion Brewery No. 254, Colombo Rd, Biyagama, Te 112465941 - e-mail - chad@lionbeer
26						
	Wind power plant	Puttalam	300 MW	CO2	10500000 t CO2 year	Mr. Mahinda Panapitiya, Director, DA M Engineering (pvt.) Ltd., No. 46, Dr Perera WM, Colombo 8- Tele- 1146 e-mail davis@sltnet.lk
27						
	Labuwewa mini hydro	Gilimale	3 MW	CO2	4965 tCO2 year	Mr. M.H. N.M. De Silva, Manager, A Power (pvt.) Ltd., No. 79/5, Horton P Colombo 7 - Tele 115333800, e-mai Aquapower@sltnet.lk
28						

CHAPTER 7 - SRI LANKA NATIONAL CDM POLICY AND STRATEGY

7.1 Introduction

The National Environmental Policy of Sri Lanka presented in the "*Caring For The Environment 2003-2007- Path to Sustainable Development*" recognizes the integration of the three pillars of sustainable development - economic, environmental and social dimensions. Sri Lanka's environmental foreign policy commitment for the protection of global climate system is in line with the United Nations Framework Convention on Climate Change (UNFCCC) which the country ratified on 23rd November 1993 and the Kyoto Protocol which was acceded to on 3rd September 2002. The National Clean Development Mechanism (CDM) Strategy for Sri Lanka to make optimum use of the CDM to the benefits of the country should be within the framework of both Sri Lanka's National Environmental Policy and Environmental Foreign Policy under the UNFCCC and the Kyoto Protocol. Sri Lanka should therefore adopt a strategy of leveraging CDM benefits for projects that meet country's development priorities and sustainable development agenda which meets country's international environmental commitments.

The world is exploring the concept of sustainable development in order *to meet the needs of the present without compromising the ability of future generations to meet their own needs.* Originally popularized through the work of the World Commission on Environment and Development, sustainable development has become widely accepted by decision makers worldwide, following the United Nations' Agenda 21. While climate change is important in the long run, it is crucial to recognize that there are a number of other sustainable development issues in Sri Lanka that affect human welfare more immediately - such as hunger and malnutrition, poverty, health, and pressing local environmental issues. Therefore, the wide-range of potential interactions of climate change with sustainable development need to be critically analyzed from a Sri Lanka national policy perspective to ensure that the country is well positioned to benefit from global carbon market and that these mitigation activities are well integrated with the other economic and social development needs of the country while protecting its unique environment. The Draft National CDM policy has been developed within the national sustainable development framework to improve economic, social and environmental indicators of the country.

7.2 National Policy on CDM

The objective of the national policy on CDM is to establish institutional, financial, human resources and legislative frameworks necessary to participate in Clean Development Mechanism (CDM) activities under the Kyoto Protocol and to develop a mechanism for trading "Certified Emissions Reductions" (CER) earned through CDM activities as important measures to achieve sustainable development. The current policy is reflected in the document on CDM released by

the then Ministry of Environment and Natural Resources (MENR). The CDM policy document is included in Appendix 2; the key features are listed below.

7.2.1 Policy Principles

a) Participation in CDM projects will be in line with existing sectoral policies.
b) CDM projects will have tangible national impacts and will contribute to the national sustainable development agenda.
c) CDM will be used to encourage private sector investments in climate-friendly development activities.
d) CDM projects will be designed so as to contribute to the improvement of the environment and the welfare of the society as a whole.
e) CDM projects will be encouraged to include elements that would contribute to poverty reduction and employment generation.
f) CDM projects will promote and encourage the inward transfer of new, proven, affordable and relevant technologies.
g) CDM projects that address local environmental issues will be especially encouraged.
h) CDM projects will be approved through a participatory and transparent process that involves a detailed assessment of their economic, social and environmental benefits and their relevance to local needs and priorities.
i) CDM projects will recognize the rights of the people of Sri Lanka in relation to all emissions, exercised through the Government of Sri Lanka.
j) Applicants for CDM projects will meet the costs associated with the evaluation of their applications by making such payment to the Climate Change Secretariat as the authority may determine.

7.2.2 Institutional Framework

a) Ministry of Environment shall be the National Focal Point for the Kyoto Protocol.
b) The Climate Change Secretariat (CCS) will function as the Designated National Authority (DNA).
c) A National Expert Committee (NEC) appointed by the Secretary MOE will evaluate CDM project proposals and make recommendations to the DNA. CCS will serve as the secretariat for the NEC.
d) Two National CDM Study Centers (CDMSC) with relevant expertise will be established to advise project proponents and the CCS on all aspects on CDM including baseline determination, pricing, project development, and negotiations with CDM buyers. In order to carryout this responsibility the CDMSC will undertake research and studies on CDM including global CDM markets, and trends.
e) The Ministry will support the private sector and institutions to establish an Emissions Trading Exchange (ETX).

7.2.3 Eligibility

a) The key sectors for the implementation of CDM projects will be Energy, Industry, Transport, Waste Disposal, Forestry, Agriculture and Plantations. The Government may decide priority sectors for CDM projects from time to time.
b) CDM project proposals shall be evaluated based on their feasibility and national benefits.
c) Proponents in CDM projects shall be entities incorporated in Sri Lanka, whether by the Registrar of Companies or other relevant authority.

7.3.4 Regulations

a) The CCS through NEC will ensure that the project developers follow the guidelines of the Intergovernmental Panel on Climate Change (IPCC) and UNFCCC through close monitoring of the project implementation.
b) The Government shall not be held responsible for delivery of CERs contracted by CDM Projects.
c) CDM Projects shall be subject to the Environment Impact Assessment (EIA) process and other applicable laws, as relevant.

7.4.5 Organizational Structure on CDM Management and Process

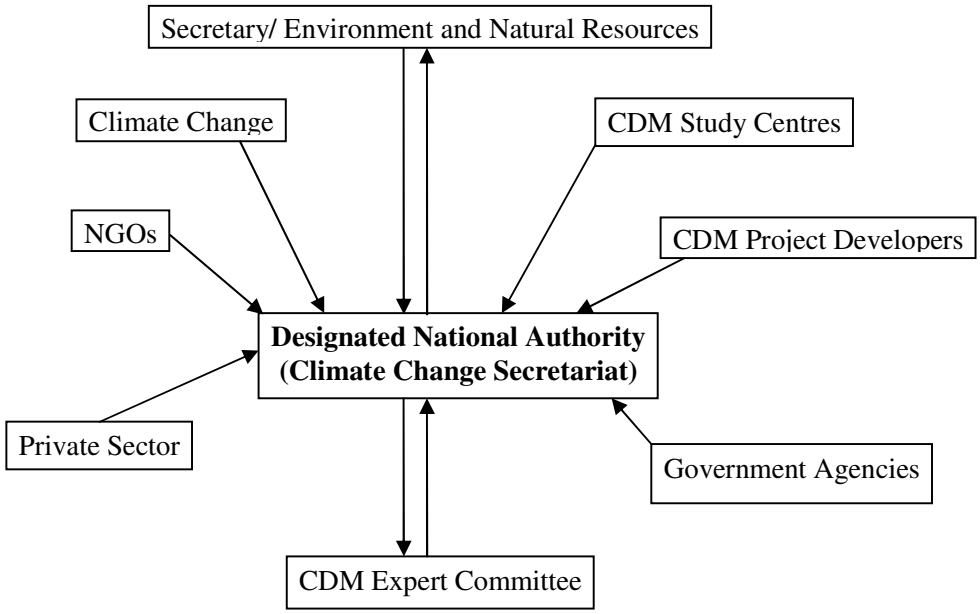
The structure of the DNA is given in Figure 13. The Climate Change Secretariat (CCS) is the key and most important entity in the functioning and promotion of CDM projects in Sri Lanka. It is the duty of the stakeholders in CDM to initiate a dialog with the DNA and persuade DNA to be more proactive.

CDM Expert Committee

The function of this committee is to facilitate the approval procedure by the DNA. The DNA is headed by the Secretary, of the Ministry. This post is usually held by a senior official with administrative background. The Expert Committee is constituted with technical experts who could advise the secretary on technical aspects of CDM. The Expert Committee would focus on national issues in general and the compliance of the project with the national sustainable development objectives and programs. The CDM project development process is shown in Figure 3 above.

.

Figure 13 - Structure of the DNA



7.3 National strategy for the implementation of the National CDM policy

Sri Lanka has a strong resource base for implementation of national CDM policy. The country also has a broad experience in using these resources. However, Sri Lanka still is in the initial stage of CDM project implementation compared to neighboring India and many other developing countries. Of 315 CDM projects registered so far only 3 projects are from Sri Lanka. Many attempts by the private sector to initiate CDM projects have failed due to the various constraints. The provisions of the CDM policy have not been implemented.

There are several important constraints that need to be resolved in order for Sri Lanka to effectively implement the National CDM Policy and compete with other countries in the carbon market and optimize the benefits of CDM while achieving sustainable development objectives of the country. Some of these important constraints which could restrict the optimum use of CDM for the benefits of country include:

Information constraints: Most stakeholders, communities, companies and farmers that could benefit from CDM are not knowledgeable on CDM programs, the demand, market trends, prices, and rules for project formulation, project development process and mode of operation of CDM. The project developers cannot design project or negotiate with investors without proper knowledge on the CERs market dynamics, sales prices of CERs in the future, buyers of CERs and emerging rules of CDM. Sri Lanka doe not have a proper information gathering and dissemination system on regularly changing CDM market.

Investment risk: Since the CDM market depends on the mid and long term foreign investments, international perception on the risk of investing in Sri Lanka has significant bearing on CDM projects. Due to existing civil conflict the country may be in a disadvantages position compared to other CDM competitors. The country has not been able to establish a link between foreign direct investments (FDI) and CDM. Sri Lanka has failed to attract CDM investors competing with other countries.

.

Financing constraints: Lack of financing mechanism for CDM project development, feasibility studies, the execution of project proper and providing equity capital is an important barrier for CDM project development in Sri Lanka. This is important since a significant aspect of CDM projects ties up with underlying financing. Carbon finance provide around 5 – 20% of the total project cost. However, mainstream financing institutions in Sri Lanka has not engaged in the CDM yet.

Institutional constraints: Inadequate institutional structures and enabling legal environment both in the private and public sector to address the implementation issues of various CDM project development cycles hinder the CDM project development in the country. Sri Lanka needs the implementation and operation of a CDM office for approval and fomentation of CDM projects, which can run effectively and transparently with strong partnership with all stakeholders.

Inadequate technical capacity: Technical capacity for the CDM project development among the stakeholders is fairly weak. This includes the capacity for effective participation of international market including strong legal and negotiation skills at international fora. The industry and project developers depend on consultants, particularly on foreign consultants whose rates are generally high. Unless the technical capacity of local institutions and consultants is built the transaction costs of CDM project in Sri Lanka will continue to be high.

If Sri Lanka to capture a considerable share of the carbon market during the first commitment period ending in 2012, the country should act past and adopt a proactive strategy to implement the country's CDM policy. The objective of the National CDM Strategy is:

> **Devdevelopment of a comprehensive carbon finance strategy incorporating education, awareness, institutional, legal, technical, economics, marketing and financial aspects of CDM in Sri Lanka in order to provide overall support for the country to enter into the global CDM market through effective implementation of the National CDM Policy.**

The National CDM Strategy should include following:

SHORT TERM

Early submission of low-hanging projects

Strategy 1: Encouraging the submission of all eligible CDM projects that are at financial closure

- In the short-term, Sri Lanka should encourage project developers for the submission of all projects that are pending completion at various stages particularly the projects that are close to financial closure. The government should facilitate the speedy implementation of these projects and undertake a comprehensive assessment of these on their contribution to sustainable development. Local sustainable development benefits should be the key factor for promoting CDM project in Sri Lanka.

Legal and Institution

Strategy 2: Providing an efficient and transparent institutional infrastructure for smooth functioning of CDM process in Sri Lanka

- The government should provide efficient and transparent institutional framework for giving host country approval very fast as the first commitment period will end in 2012. Therefore, the development of an institutional infrastructure for smooth functioning of CDM in the country is necessary. Since there could be conflicting interests among the large number of agencies involved in the CDM i.e Ministry of Finance, Power and Energy, Transport, Industries and Municipalities, the legal mandate of each partner should be clearly defined and regulated.

- Sri Lanka National CDM office (DNA) should be equipped with skilled human resources, infrastructure facilities, technical, legal and marketing units in order to provide all kind of services such as providing information and data, promotion of CDM concept, interaction with international agencies and efficient processing of project approval requests.

- Sri Lanka National CDM office (DNA) should operate on a targeted action plan which should be developed synergizing with sectoral agencies, Central Environmental Authority, Ceylon Electricity Board, private sector, industry associations, municipalities, consulting companies and NGOs that are engaged in CDM activities.

Information

Strategy 3: Development of a speedy CDM information and data flow to stakeholders

- One of the barriers that hinder the CDM project development is the lack of access to data and information. The data available with state agencies and private sector are not some times accessible for project developers. Project developers are often time not aware of the data sources. The government should collect and compile the relevant data and make them available in public domain through a dedicated website for project developers to access.

- The government should also play a facilitative role in terms of building capacity of private sector, providing training and streamlining data availability rather than just playing a regulatory role.

Establishment of baselines

Strategy 4: Analysis and establishment of baselines in key sectors and make them available for project developers

- One of the major difficulties faced by project developers and CDM consultant is the development of baselines. This is due two reasons. One is the baseline methodologies are being frequently changed so that developers are nor aware of which the latest methodology. The other is that developers do not have access to data necessary from both private and state agencies. The government should intervene and develop baselines and make them available for developers to use.

Financing

Strategy 5: Establishment of financial intermediately network and encourage them to recognize the CDM revenues as co-laterals

- Financial institutions in Sri Lanka are not yet convinced on the potential benefits of CDM and as a result they are not proactive in providing accelerated funding for CDM projects. The government should intervene and facilitate the establishment of a financial intermediately network for promoting investments for CDM projects. The government may also develop a mechanism to share some of the perceived risks of CDM by the financial institutions.

- The government should encourage financial institutions to create special funding arrangements to provide finance for CDM projects which may not be able to compete with other projects.

National Carbon Fund

Strategy 6: Establishment of a Sri Lanka carbon Fund to provide financial support to projects with national importance.

- The projects which provide clear sustainable development benefits including poverty alleviation providing rural employment etc. may not be viable only with CDM revenues. Therefore the government should develop a mechanism to bridge the investment gaps of the projects with significant co-benefits in terms of sustainable development.

- The establishment of a corpus Carbon Fund for supporting small CDM project development with contributions from the government and other bilateral and multilateral donor agencies is required to promote small CDM projects with high co-benefits in terms

of sustainable development. This fund could provide assistance for CDM project development including the creation of bundling organizations to encourage bundling of small CDM projects, providing equity capitals for nationally important projects that provide clear social, community and sustainable development benefits.

Unilateral CDM

Strategy 7: Encourage the implementation of unilateral CDM projects

- Most CDM projects in Sri Lanka have been delaying implementation due to non-availability of buyers. Sri Lanka should develop a strategy to promote and implement unilateral CDM for which buyers can be contracted at any project development stage. Building capacity for the development of unilateral CDM is a priority.

Avoid perverse incentives

Strategy 8: Improve institutional coordination to make sure not to create perverse incentives by sectoral policies

- Make sure that country's existing and proposed policies and regulations do not hinder the CDM development in the country. In introducing new policies and regulations may penalize some CDM projects on additionality ground. Before new regulation are introduced, the trade off between new regulation and CDM additionality needs should be reviewed. Improving coordination between sectoral policy development and CDM rules and regulation can avoid creating perverse incentives for CDM project development.

Capacity building

Strategy 9: Training and building capacity of local CDM stakeholders

- In Sri Lanka the CDM project development process is entirely dependent upon local or foreign consultants. The level of capacity of CDM stakeholders, particularly among the project developers is very low. Most CDM project developers are not fully aware of the potential benefits and risks involved in the CDM project development. This is one of the reasons for only 3 CDM projects registered from Sri Lanka so far. The government should coordinate with other bilateral and multilateral agencies to provide specific training on financial, legal and other CDM rules to stakeholders of important sectors.

- The government should adopt a coordinated approach to interact with bilateral and multilateral programs available for CDM capacity building in order to maximize the outreach impacts and maintain continuity of capacity building programs avoiding duplication.

- The CDM project development cost in Sri Lanka is very high as a result of heavy dependent upon the international consultants. The government should take initiatives to build the capacity of local experts and agencies as a cost reduction measure.

Bundling

Strategy 10: Encourage bundling of small scale CDM projects creating special purpose institutional arrangements suitable for bundling

- In Sri Lanka many CDM projects are small scale, which are not attractive to CERs buyers due to high transaction costs. CDM rules allow the bundling of these small scale projects in order to reduce the transaction costs. However, experience suggests that the bundling of projects belongs to different project developers is complicated and requires specific administrative, institutional, legal and technical skills. Therefore local entities that have necessary technical, administrative, and legal skills should be identified and built their capacity for undertaking bundling CDM projects. The government may coordinate with bilateral and multilateral agencies to build the capacity of such bundling organizations to facilitate the PDD preparation, validation, registration, verification and marketing of CERs of bundled CDM projects.

MEDIUM TERM

Taxing CERs and defining Ownership

Strategy 11: Defining ownership of CERs and providing tax incentives

- The ownership of CERs should be clearly defined since project developers may have concerns of the possible government claiming sole ownership of the CERs. This is particularly important when sharing CERs among the project developers of bundled CDM projects.

- Project developers are also concern of the government imposing tax on CERs in the future. Sri Lanka should give tax incentives for the first commitment period. This will encourage CDM project developers.

Arbitration

Strategy 12: Develop an inexpensive dispute redress scheme suitable for small scale CDM partners

- It is the responsibility of the government to provide a low cost dispute resolution mechanism to settle any dispute arisen with regard to a CDM project. In Sri Lanka most of the CDM projects are bundled small projects. For these small CDM partners whose financial capability is lower than that of large CDM project partners, inexpensive dispute redressal scheme such as arbitration is a viable alternative.

Carbon Trading Exchange

Strategy 13: Development of a CERs marketing system such as carbon trading exchange to support small CDM developers

- Marketing of CERs is an urgent issue that needs special attention in order to develop Sri Lanka CDM market. This is particularly relevant for small scale project developers. There is no mechanism for a small CDM project developer to access an international buyer. Only a few international buyers operate in Sri Lanka. They are also not accessible to small project developers. Therefore a state sponsored Carbon Trading Exchange (CTX) that buys and sells CERs should be established. The CTX should be equipped with experts of marketing experience. The government should provide initial seed money for the CTX to operate and eventually it should run itself on commercial basis.

CDM study and reference center and Strategic Research studies

Strategy 14: Establishment of CDM study and research center to provide technical and scientific information and data to CDM stakeholders

- An independent CDM study and reference center may be established in partnership with government, universities, private sector and NGOs to function as repository of CDM information and provide technical support for all stakeholders.

- Linkages between macro-economic, sectoral and sustainable development policies and benefits of Sri Lanka participating in the carbon offset market.

- Relationships between global benefits and collateral local/national benefits in Sri Lanka and potential areas for synergies between local and global environmental policies.

- Development of the demand, market trend and prices for CERs in the global CDM market.

- Sectoral development options of Sri Lanka with respect to achieving emission reductions, in particular regarding project types (e.g., energy production, energy end use (demand side management), industrial sources, transport, land use and forestry, waste management etc., and non-CO_2 emission sources and the priority areas for carbon finance investments in the country

- Options available for Sri Lanka for the short term, medium term and long term market considering the possible scenarios for post Kyoto carbon offset market.

- The international and national constraints that can limit the development of the CDM potential in Sri Lanka.

LONG TERM

Policy CDM

Strategy 15: Explore the policy CDM potential in the country and enhance the capacity to implement

- Adopt a comprehensive approach to develop project that are in the initial stage which need several years for the project development so that most likely during the first commitment period these projects will not deliver considerable CERs. It is now too late to start large projects which require many years for project development. The target should be to develop these projects for the second commitment period.

- The concept of sectoral and policy CDM is being widely discussed. With sectoral CDM a large volume of emission reductions is possible. The transaction cost of sectoral CDM projects is lower than that of project based CDM. Sri Lanka should develop institutional framework including technical, economic, methodological capacity for the development and implementation of sectoral CDM targeting the second commitment period.

Local DOE

Strategy 16: Facilitate the creation of local designated operational entity

- The government should also facilitate the accreditation of a local Designated Operation Entity (DOE) in order to reduce the cost of validation and verification, which accounts for a significant percentage of CDM transaction cost.

State sector CDM

Strategy 17: Identify and develop state sector CDM potential

- State sector has a large CDM potential which has never been studied and explored. These projects can be developed as a long term measure.

CHAPTER 8 – ACTION PLAN FOR THE IMPLEMENTATION OF NATIONAL CDM STRATEGY

Table 24 - Logical framework and action plan

Intervention Logic			**Results**	**Indicators**
OVERALL OBJECTIVE Devdevelopment of a comprehensive carbon finance strategy incorporating education, awareness, institutional, legal, technical, economics, marketing and financial aspects of CDM in Sri Lanka in order to provide overall support for the country to enter into the global CDM market through effective implementation of the National CDM Policy				
1. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 1: EARLY SUBMISSION OF LOW-HANGING PROJECTS **Encouraging the submission of all eligible CDM projects that are at financial closure**				
Outputs/Results Area 1 A project pine line is developed	**Activities** 1.1 Calling CDM project proposal (PINs and PDDs) from private sector that are ready to implement 1.2 Create awareness among project partners on the urgency of submitting these project as early as possible 1,3 Prioritize the projects based on their project development maturity level 1.4 Facilitate existing project proponents to access Carbon Finance 1.5 Make arrangement to complete PDDs by providing technical Support			

	1.6 Organize a joint validation program for all PDDs and submit for registration 1.5 Organize a joint marketing program			
Outputs/Results Area 2 National facilitating committee set up to speedy submission of CDM projects	**Activities** 2.1 Appointing a National facilitating Committee consisting of public officers, project developers, and technical consultants 2.2 Prepare a time bound action plan to submit CDM projects and monitor			
Outputs/Results Area 3 **A local carbon trade fair organized**	**Activities** 3.1 Prepare institutional arrangements for a carbon trade fair 3.2 Establish the Sri Lanka Emission Trading Exchange as a partnership organization with public and private sector 2.2 Organize annual trade fair inviting both local and international buyer			
2. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 2: LEGAL AND INSTITUTION **Providing an efficient and transparent institutional infrastructure for smooth functioning of CDM process in Sri Lanka**				
Outputs/Results Area 1 An institutional analysis and development	**Activities** 1.1 Assess the institutional capacity of DNA, identify weaknesses and gaps to implement the National Strategy			

Outputs/Results Area 2 Efficient DNA office established	**Activities** 2.1 Strengthened the DNA finalizing the associated institution and legal processes 2.2 Establish stakeholder coordination system 2.3 Provide guidance and measures to improve process 2.4 Institutional development for LULUCF CDM 2.1 Development of the institutional capability of private sector to address CDM 2.5 Establishment of legal and marketing unit at the DNA 2.6 Prepare a business plan for DNA office operation			
Outputs/Results Area 3 SD criteria and forest definitions established	**Activities** 3.1 Development of sustainable development criteria 3.2 Establish Sri Lanka Forest Definitions			
Outputs/Results Area 4 Project approval procedure streamlined	**Activities** 4.1 Development of CDM project approval procedure 4.2 Prepare the template for approval letter			
Outputs/Results Area 5	**Activities**			

CERs/RUs marketing procedure established	5.1. Establishment of project negotiation procedure and marketing CERs /developers perspectives			
Outputs/Results Area 6 Model sales agreement prepared	**Activities** 6.1 Preparation of model sales agreement for CERs/RU for use by project developers			
Outputs/Results Area 7 DOE check list prepared	**Activities** 7.1 Development of validation and verification options available for Sri Lanka 7.2. Checklist of information required for validation and certification process			
3. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 3: INFROMATION **Development of a speedy CDM information and data flow to stakeholders**				
Outputs/Results Area 1 A CDM reference cell is established	**Activities** 1.1 Establishment of CDM information cell at the DNA office 1.2 Collect most recent CDM documents and relevant national data and prepare in a suitable format for easy access to developers 1.3 Develop and maintain national CDM website and linked it to UNFCCC CDM website 1.4 Create awareness on the data sources related to CDM			
Outputs/Results Area 2	**Activities**			

CDM related data dissemination policy and guideline established	2.1 Prepare CDM data dispatch policy and guideline 2.2 Coordinate with line agencies to make data available for project developers			
4. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 4 - BASELINE **Analysis and establishment of baselines in key sectors and make them available for project developers**				
Output /Result Area 1 Generic national energy sector baseline is established	**Activities** 1.1 Development of national baseline for energy sector using all applicable methods			
Outputs/Results Area 2 Generic sector baselines established	**Activities** 2.1 Development of generic sector baselines for solar, hydro, dendro, wind, energy efficiency and demand side management 2.2 Development of national baseline for waste management using applicable methods 2.3 Development of national baseline for industrial sector using applicable methods 2.4 Development of national baseline for transport sector using applicable methods 2.5 Development of national baseline for agriculture sector using applicable methods			

Outputs/Results Area 3 Marginal abatement cost (MAC) for emission reduction established	3.1 Analysis of marginal abatement cost (MAC) of emission reductions under various project options			
Outputs/Results Area 4 Generic national baseline for LULUCF sector is established	4.1 Development of national baseline for LULUCF using applicable methods			
Outputs/Results Area 5 LULUCF Sector baselines are established	5.1 Development of generic sector baselines for agro-forestry, wetzone forest, dry forest, savanna and montane forests and plantation sector 5.2 Development of additionality testing procedure			
Outputs/Results Area 6 Project baseline for selected LULUCF projects established	6.1 Development of project baselines (example) selected LULUCF sector projects			
Outputs/Results Area 7 Small scale CDM project baseline for LULUCF projects established	7.1 Development of project baselines for small scale CDM project – LULUCF 7.2 MAC assessment procedure for LULUCF projects is Established			
5. SPECIFIC PROJECT OBJECTIVES/STRATEGY 5 – FINANCIAL INTERMEDIARY				

Establishment of financial intermediately network and encourage them to recognize the CDM revenues as co-laterals				
Output /Result Area 1 A financial intermediary network established	**Activities** 1.1 Identify potential for financial institutions and establish financial intermediary network 1.2 Capacity Building in private sector financial institutions 1.3 Engage the finance/banking sector for CDM activities through awareness raising on potential benefits from CDM 1.4 Encourage financial sector for creating special funding arrangements for CDM financing			
6. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 6 – CARBON FUND **Establishment of a Sri Lanka carbon Fund to provide financial support to projects with national importance**				
Outputs/Results Area 1 A carbon corpus fund established	**Activities** 1.1 Develop institutional arrangement for the carbon fund 1.2 Create awareness on the carbon fund and initiate political consultation process 1.3 Secure funds from the treasury and develop replenishment program			

	1.4. Implement fund utilization program particularly for projects with high national benefits			
7. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 7 - UNILATERAL CDM **Encourage the implementation of unilateral CDM projects**				
Outputs/Results Area 1 Capacity of project developers built on unilateral CDM	**Activities** 1.1 Facilitate project developers to undertake unilateral CDM projects when they cannot find buyers at the initial stage 1.2 Create awareness on the unilateral CDM			
8. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 8 - AVOID PERVERSE INCENTIVES **Improve institutional coordination to make sure not to create perverse incentives by sectoral policies**				
Outputs/Results Area 1 National policy development coordination system established	**Activities** 1.1 Improve understanding among state agencies to avoid making policies that impacts on CDM additionality			
9. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 9 – CAPACITY BUILDING **Training and building capacity of local CDM stakeholders**				

Outputs/Results Area 1 Key local experts trained	**Activities** 1.1 Training of project developers and experts on PDD preparation, project approval procedure, role of DNA, project negotiation, marketing of CERs/RMU, signing agreements, monitoring, verification and validation 1.2 Provide support for Climate change secretariat and the Ministry of Environment to carry out CDM promotion, assessment, DNA functions for main staff members			
Outputs/Results Area 2 Awareness of policy makers and political leaders created	**Activities** 2.1 Capacity building of Ministries of finance, industries and investment promotion 2.2 Capacity building of ministries of Power and Industries 2.3 Capacity building of Local authorities and provincial councils			
Outputs/Results Area 3 Awareness of school children created	**Activities** 3.1 School awareness creation program 3.2 University awareness creation program			
Outputs/Results Area 4 Awareness of media personnel created	**Activities** 4.1 Media awareness creation program			
Outputs/Results Area 5 Awareness of private sector	5.1 Private sector awareness creation program			

project developers created				
10. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 10- BUNDLING **Encourage bundling of small scale CDM projects creating special purpose institutional arrangements suitable for bundling**				
Outputs/Results Area 1 Capacity bundling for bundling of small scale CDM projects built	**Activities** 1.1 Training of project developers and experts on the bundling of small scale CDM projects			
Outputs/Results Area 2 Special institutional set up for bundling CDM projects developed	**Activities** 1.1 Develop model institutions set up for grouping several project developers for bundling CDM projects			
11. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 11- TAXING CERs **Defining ownership of CERs and providing tax incentives**				
Outputs/Results Area 1 Legal ownership of CERs are defined	**Activities** 1.1 Introduction of regulations and guidelines on ownership of CERs, particularly when sharing the credits			
Outputs/Results Area 2 Tax incentives for CDM project introduced	**Activities** 1.1 Introduction of the government policy on taxing CERs revenue and providing tax incentives			

12. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 12- ARBITRATION **Develop an inexpensive dispute redress scheme suitable for small scale CDM partners**				
Outputs/Results Area 1 An arbitration system introduced	**Activities** 1.1 Develop dispute redress scheme to settle issue regarding CDM projects			
13. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 13- CARBON TRADING EXCHANGE **Development of a CERs marketing system such as carbon trading exchange to support small CDM developers**				
Outputs/Results Area 1 Carbon Trading System Established	**Activities** 1.1 Establishment of Carbon Trading Exchange with participation of private and government to market CERs			
Outputs/Results Area 2 Tax incentives for CDM project introduced	**Activities** 1.1 The government policy on taxing CERs revenue introduced and provide tax incentives			
14. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 14- CDM STUDY AND REFERENCE CENTER AND STRATEGIC RESEARCH STUDIES **Establishment of CDM study and research center to provide technical and scientific information and data to CDM stakeholders**				

Outputs/Results Area 1 A CDM study center Established	**Activities** 1.1 Establishment of a CDM study center with participation of universities to provide technical inputs			
Outputs/Results Area 2 Key CDM studies are undertaken	**Activities** 1.1 Study linkages between macro-economic, sectoral and sustainable development policies and benefits of Sri Lanka participating in the carbon offset market 1.2 Study the relationships between global benefits and collateral local/national benefits in Sri Lanka and potential areas for synergies between local and global environmental policies. 1.3 Study the sectoral development options of Sri Lanka with respect to achieving emission reductions in the short term, medium term and long term market 1.4 The international and national constraints that can limit the development of the CDM potential in Sri Lanka.			
15. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 15- POLICY CDM **Explore the policy CDM potential in the country and enhance the capacity to implement**				
Outputs/Results Area 1 Policy CDM potential studied	**Activities** 1.1 Feasibility study on policy and sectoral CDM potential for Sri Lanka 1.2 Development and implementation of policy CDM projects			
Outputs/Results Area 2 Technical capacity for policy	**Activities** 1.1 Training and capacity building for the implementation of			

CDM built	Policy CDM			
16. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 16- LOCAL DOE **Facilitate the creation of local designated operational entity**				
Outputs/Results Area 1 Establishment local DOE facilitated	**Activities** 1.1 Identification of potential local certification agencies 1.2 Facilitation of accreditation of a local DOE			
17. SPECIFIC PROJECT OBJECTIVES/ STRATEGY 16- STATE SECTOR CDM **Identify and develop state sector CDM potential**				
Outputs/Results Area 1 State sector CDM potential identified	**Activities** 1.1 Study the policy CDM options for Sri Lanka 1.2 Development of national baseline for Policy CDM projects – energy, waste, industry, agriculture, transport, LUUCF 1.3 Analyze the marginal cost of selected policy CDM projects 1.4 Prepare a project pipeline of policy CDM 1.5 Encourage state agencies to submit possible state sector CDM projects			

CHAPTER 9 – RECOMMENDATIONS

References