CDM – Executive Board

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

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Annexes

Appendices (provided as spreadsheets)

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Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Mampuri Wind Power Project

A.2. Description of the small-scale project activity:

Mampuri Wind Power Project will be located in the general area of the Mampuri village in the North Western Province of Sri Lanka. The Project is being developed by Senok Wind Power (Pvt) Ltd. (SWPL), a Sri Lankan company. It will use the wind energy potential in the North West coastal belt of Sri Lanka to produce a total of 10 MW using eight wind turbines, each rated at 1.25 MW. The power plant is expected to generate 27.638 GWh per year, on the basis of long-term average wind speeds at the location. Electricity produced will be sold to Ceylon Electricity Board (CEB), the national electricity utility, through a dedicated transmission line. The Project has been designated by the Sri Lanka Sustainable Energy Authority and Ceylon Electricity Board (CEB) as a Small Power Project (SPP), and its operations and sale of electricity will be governed by the Permit issued by Sri Lanka Sustainable Energy Authority (SEA), and the standardised Small Power Purchase Agreement (SPPA) signed with CEB. The Permit has been already issued and the SPPA has already been executed. The SPPA is a standardised, 20-year, non-negotiable contract, and defines a standardised tariff for the sale of electricity on the basis of a generic wind power plant and other financial indices at the time of calculating the tariff.

CEB's generating system is dominated by thermal power plants, presently using diesel, fuel oil and naphtha, and will use coal in the future. A range of diesel engines, open cycle gas turbines and combined cycle gas turbines are presently used, while a coal-fired power plant is under construction. Energy share from thermal power plants was 60% in 2007, and is expected to exceed 80% by year 2020. Electricity generated from the Mampuri Wind Power Plant will displace the fossil fuels used and the corresponding emissions from the oil and coal power plants.

Mampuri Wind Power Plant is estimated to displace 18,771 tCO_2 per year at an emission factor of 0.6792 $kgCO_2$ per kWh. It will also avoid other emissions such as SO_x and NO_x from thermal power plants throughout Sri Lanka. The Project will improve the road along the coast at Mampuri, which will enhance the mobility of villagers in Maupuri. Several community service initiatives will be implemented by the project participant.

The Mampuri Wind Power Plant is potentially the first commercial wind power plant to be built in Sri Lanka, scheduled to be operational in 2009. The Power Plant will be located adjoining the southern perimeter of the Puttalam Coal Power Plant, which too is the first coal-fired power plant in Sri Lanka, presently under construction and scheduled to be operational in year 2011.

A.3. Project participants:

Senok Wind Power (Pvt) Ltd (SWPL), a company incorporated under the Companies Act No 7 of 2007, is the only project participant. The project participant is a fully-owned subsidiary of Senok Trade Combine Limited, a diversified group in Sri Lanka in the business of travel, automobiles, heavy machinery, renewable energy, value added tea and in construction, for over 25 years.

Contact information of the project participant is provided is Annex 1.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

The project is located on the north western coast of Sri Lanka, in the North Western Province. The site is centred on the village of Mampuri. Wind turbines will be spread over a distance of 3.5 km along the coastline, and built on the coast, beyond the statutory limits from the waterfront. The site is accessed by turning from A3 Colombo-Puttalam road at the Palavi junction, to B 349 Palavi – Kalpitiya road, and then by turning left at the Mampuri junction (approx 12 km from Palavi).

A.4.1.1. Host Party(ies):

The host party is the Government of the Democratic Socialist Republic of Sri Lanka.

Sri Lanka ratified the United Nations Framework Convention for Climate Change on 23rd November 1993, and subsequently acceded to the Kyoto Protocol on 3rd September 2002.

Sri Lanka submitted the first National Communication under the UNFCCC on 27th October 2000.

A.4.1.2. Region/State/Province etc.:

Province: North Western
District: Puttalam
Local Authority: Kalpitiya Pradeshiya Sabha
Village: Mampuri

A.4.1.3. City/Town/Community etc:

Wind Power Plant centred on the Mampuri Village, distributed along a 3.5 km coastal belt

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

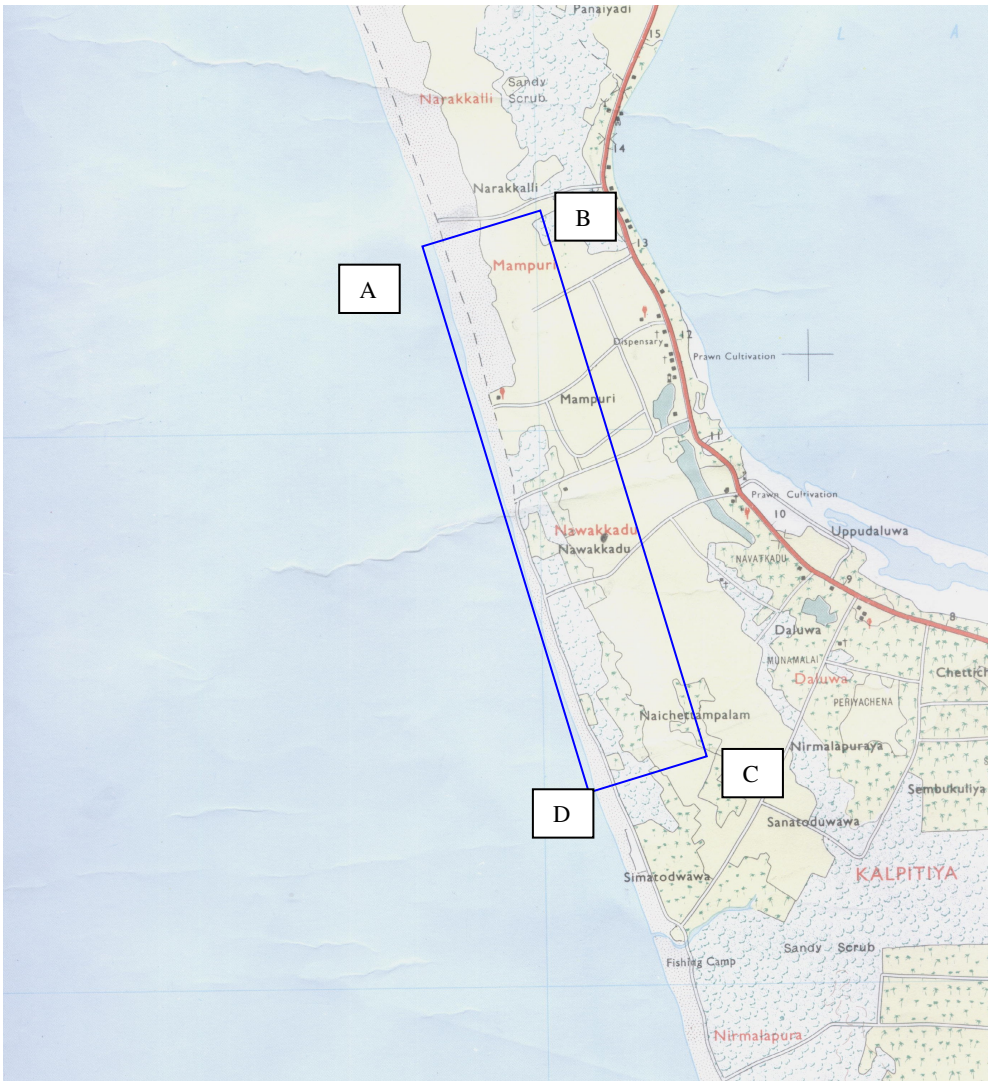
The site is accessed by turning from A3 Colombo-Puttalam road at Palavi, to B 349 Palavi – Kalpitiya road. When travelling from Palavi towards Kalpitiya along this road, turn left at the Mampuri junction, which is approximately 12 km from Palavi. Move through the Mampuri village to reach the beach front, along which the site is located.

GPS coordinates of the site allocated to the Mampuri Wind Power Plant are the following:

Site boundaries	
Latitude	Longitude
8^{o} 0.65’	79^{0} 43.19’
8^{o} 0.65’	79^{0} 43.60’
7^{o} 58.00’	79^{o} 44.50’
7^{o} 57.90’	79^{o} 44.00

For more details of the site boundaries, please see Figure 1.

Figure 1- Boundaries of the Site Allocated to the Project



Site boundaries

	Site boundaries	
Position	Latitude	Longitude
A	8° 0.65’	79° 43.19’
B	8° 0.65’	79° 43.60’
C	7° 58.00’	79° 44.50’
D	7° 57.90’	79° 44.00

The eight wind turbines will be located within the above site boundaries. The distance from the northern-most wind turbine (WTG1) and the southern-most wind turbine (WTG8) will be 3.5 km.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

Using the categorisation stated in **Appendix B to the Simplified Modalities and Procedures for Small-scale CDM Project Activities**, the Project type and category are defined as follows:

The Project is of Type I: Renewable Energy Projects
The Project is of Category I.D: Grid Connected Renewable Electricity Generation

Technology/measure:

The project will develop a wind power plant to harness the wind potential along a 3.5 km coastal belt.

Each wind turbine will be located within a block of land of approximate dimensions 150 m x 100 m. Foundation for the wind turbine will be located approximately in the middle of its block of land. The turbine mast will be of tubular structure, transported in sections and assembled on site. Each turbine will consist of three blades, each of length 31 m. The nacelle will house the gearbox and the electricity generator. The generator will be of induction type.

The generating voltage will be 690 V. Power generated will be connected to a step-up transformer located at the foot of each turbine mast, where the voltage will be raised to 33 kV to be compatible with the medium voltage transmission system of CEB. There will be a 33 kV transmission line along the entire 3.5 km length of the wind park, to which the output of each turbine will be connected. At a location approximately in the middle of the park, there will be a central switching arrangement to connect the wind power plant to the CEB network. CEB's metering point will be located immediately after this interconnection point. A new 33 kV transmission line from the CEB metering point located in the middle of the wind park to reach the national grid will be built by the project.

Being potentially the first commercial wind power plant to be built in Sri Lanka, this project will introduce new but proven technology to the host country.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The crediting period chosen in this PDD is seven years, with an option to renew it twice thereafter.

Total number of years = seven (7)
Annual average emission reductions = 18,771 tCO_2

The Mampuri Wind Power Plant will be connected to the national grid at the Palavi gantry. Electricity produced at the power plant will avoid emissions from thermal power plants that would have supplied the national grid of Sri Lanka, by reducing their electricity generation by an equivalent amount of energy plus the reduced transmission losses incurred by CEB to supply its customers through Puttalam and nearby grid substations, and from the Palavi gantry.

The key parameters and the estimated amount of emission reductions are further described below:

Installed generating capacity of the Mampuri Wind Power Plant	10	MW
Annual capacity factor under average wind conditions	31.55	%
Average energy sold to Ceylon Electricity Board	27.638	GWh/year
Emission factor (see calculations later in this PDD)	0.6792	$kgCO_2/kWh$
Annual average emission reductions	18,771	$tCO_2/year$
Estimated amount of emission reductions over the chosen **crediting period of seven years**	131,397	tCO_2

Estimated emission reductions over the seven-year crediting period

Year	Period	Estimated emission reductions (tCO_2)
2009	1st October to 31st December	4,693
2010	1st January to 31st December	18,771
2011	1st January to 31st December	18,771
2012	1st January to 31st December	18,771
2013	1st January to 31st December	18,771
2014	1st January to 31st December	18,771
2015	1st January to 31st December	18,771
2016	1st January to 30th September	14,078
Total estimated emission reductions over the crediting period		131,397
Total number of years		7
Annual average emission reductions (tCO_2)		18,771

A.4.4. Public funding of the small-scale project activity:

The project will be entirely financed by Senok Wind Power (Pvt) Ltd, through loans from commercial banks in Sri Lanka and equity provided by the holding company, Senok Trade Combine Limited. No public funds either from Annex 2 Parties, from the host party (Sri Lanka) or any other country would be used for any element of this small scale CDM project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The Mampuri Wind Power Project is being developed and the power plant will operate on the basis of the Energy Permit issued by Sri Lanka Sustainable Energy Authority, and a Small Power Purchase Agreement with Ceylon Electricity Board. Both the Permit and the Agreement are specific to the project. The energy permit has already been issued (on 5th December 2008, valid for 20 years from the commercial operation date) and the small power purchase agreement has already been executed on 16th December 2008 (valid for 20 years from the Commercial Operation Date). The project is presently (15th April 2009) in the fifth month out of the two-year period allowed in the energy permit for the construction activities. The project activity is a stand-alone activity, with a capacity limitation of 10 MW stipulated in both the energy permit and the small power purchase agreement, and therefore, it is **not a debundled component** of a large scale project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The Project category title is **Category I.D: Grid Connected Renewable Electricity Generation** Reference for the approved baseline and monitoring methodology is: **EB36 AMS-I.D "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories" version 13**.

B.2 Justification of the choice of the project category:

The Project would produce electricity from the wind potential available in the coastal belt, centred on the Mampuri village. The power plant will have a total installed capacity of 10 MW, and all the output will be directly supplied to the national grid of Sri Lanka, which is managed by Ceylon Electricity Board. The power plant is classified by CEB as a Small Power Project (SPP), which should by definition be less than 10 MW. The project uses renewable energy to produce electricity to supply the grid, and is less than 15 MW, and thus the category I.D is the most appropriate category for this small scale CDM project activity.

With reference to **EB36 AMS-I.D "Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories" version 13**, on which the choice of project category was based, the following are the specific reasons to select the project category I.D.

Technology/measure

1. The project comprises renewable energy electricity generation units using wind, and will supply electricity to displace electricity from an electricity distribution system that would have been supplied by several fossil fuel fired generating unit.
2. The project has only renewable units (wind) and the total capacity is 10 MW.
3. The project has no combined heat and power units.
4. This project is not one that adds renewable energy electricity generation units at an existing renewable power generation facility, and is in any case, less than 15 MW.
5. Project activities do not seek to retrofit or modify an existing facility for renewable energy generation, and is in any case, less than 15 MW.

B.3. Description of the project boundary:

The project boundary will be the physical boundary of the project, extending over a 3.5 km length along the coastline. Please see the layout diagram previously given in Section A4.1.4 in Figure 1.

B.4. Description of baseline and its development:

The baseline for this project are the emissions from the electricity generating system in Sri Lanka supplying the national grid. The national grid is owned and managed by Ceylon Electricity Board (CEB), the state-owned electricity utility. The national grid serves about 80% of households, nearly all the commercial and industrial customers, while a further estimated 2.5% of households use off-grid electricity supply systems.

Historic development of electricity generation in Sri Lanka: Sri Lanka's electricity development was initially focussed on developing conventional hydropower resources. Commencing from year 1950, a total of 1205 MW of medium and large hydropower generating capacity has been built by end 2007, to supply the national grid. (See Table 1). In year 1995, Sri Lanka produced 95% of the grid electrical energy requirements from such conventional hydropower plants. However, with no major new hydroelectric projects to be developed, the dominance of hydropower changed dramatically from 1996 onwards. The growing demand for electricity had to be met with new thermal power plants. Between 1996 and 2008, Sri Lanka added 965 MW of oil-fired power plant to meet the growing demand for electricity. Over the same period, households using electricity rose from 47% to 80% and a similar increase in demand was observed from commercial and industrial customers. In year 2007, 59.8% of energy in the national grid was sourced from oil-fired thermal power plants (see Table 2). In a year when hydropower output decreases owing to adverse weather, the share of electricity from oil-fired thermal power plant increases to about 65%.

Table 1- Types of power plants in operation in the Sri Lanka national grid as of 31st December 2007

Types of Power Plants	Installed Capacity (MW)	Share of Total Capacity	Gross Energy Dispatched to the Grid in 2007 (GWh)	Share of Total Energy
Hydro and other renewables				
CEB Hydro Power Plants	1205.0	50.1%	3,602.9	36.7%
Small Power Producers (Hydro)	117.1	4.9%	342.8	3.5%
Small Power Producers (Biomass, solar)	2.1	0.1%	1.3	0.0%
CEB Wind Power Plant	3.0	0.1%	2.3	0.0%
Total hydro and other renewables	**1327.2**	**55.2%**	**3,949.2**	**40.2%**
Thermal Power Plants using Fossil Fuel				
CEB Thermal : Petroleum	528.0	22.0%	2,335.5	23.8%
IPP Thermal : Petroleum	550.1	22.9%	3,528.5	36.0%
Total thermal power plants fossil fuel	**1078.1**	44.8%	**5,864.1**	**59.8%**
Total Grid connected power plants	**2405.3**	**100.0%**	**9813.3**	**100.0%**

Note: Installed capacity data as of end December 2007
Sources:
1. CEB Long-term Generation Expansion Plan Dec 2005
2. Sales and Generation Data Book, CEB, 2007

Note 1: The connected electricity system is the national electricity grid of Sri Lanka
Note 2: One new oil-fired power plant of 200 MW was commissioned during year 2008, but not included in the above list because the published information is available only up to December 2007 at the time of submission of the PDD to DOE. For more details of power plants, see Table A3.1 in Annex 3.

Table 2- Sri Lanka generating capacity share on the grid by source (2007)

Primary Source	Installed Capacity (MW)	Share of Total Capacity	Gross Energy Dispatched to Grid in 2007 (GWh)	Share of Total Energy
Hydro	1,322.1	55.0%	3,945.6	40.2%
Biomass, solar	2.1	0.1%	1.3	0.0%
Wind	3.0	0.1%	2.3	0.0%
Fossil Fuel (oil)	1,078.1	44.8%	5,864.1	59.8%
Total	2,405.3	100.0%	9,813.3	100.0%

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The Small Power Project (SPP) Development Program: Electricity generation from large hydroelectric power plants is considered to be a conventional approach in Sri Lanka. Renewable energy-based electricity generation from non-conventional renewable energy sources (NCRE) received a new impetus in 1996, when the Government announced a standardised power purchase agreement and a standardised tariff for private developers of NCRE-based power plants. By end 2007, a total of 68 power plants have been built by private developers under the SPP development program, including 64 small hydroelectric power plants, two biomass power plants, one waste heat power plant and one solar PV system. In spite of the SPP development program being available since 1996, and open to wind power developers as well, no wind power plants have been built as yet on this scheme. The Mampuri Wind Power Plant will potentially be the first commercial wind power plant in Sri Lanka. The reasons for the non-implementation of wind power projects under the SPP program over the past 12 years are (a) lack of information and analytical capability on wind resources (b) financial constraints imposed by the lower (avoided cost based) standardised tariff which was technology-neutral, compared with rising equipment costs, finance costs and (c) moderate wind regime in Sri Lanka resulting in lower annual capacity factor

Sri Lanka presently has only one grid-connected wind power plant rated at 3 MW built and operated by the national electricity utility, the CEB. This power plant is located in the Hambantota District in the southern province. This CEB power plant is not a commercial power plant and was built with concessionary finance from international lending agencies.

Future Electricity Generation in Sri Lanka: Sri Lanka hydroelectric potential, for both large and small developments for power generation, is limited. All the small hydropower development sites in the capacity range of 250 kW to 10 MW have either been developed already or in various stages of development. A few large projects beyond the 10 MW limit allowed in the SPP program, remain yet to be developed, most of which are associated with new irrigation schemes. Very small and micro-hydro power projects remain to be developed, but there too, the total potential is limited. Thus Sri Lanka's electricity generating system is presently dominated by oil-fired electricity generation, and in the future, it will be dominated by coal-fired power plants. Table 3 shows the published long-term generation expansion plan of CEB, which shows the planned dominance of coal-fired power generation in the future, while phasing out the existing oil-fired generation. The first coal-fired power plant scheduled for operation by year 2011 (see Table 3) is presently under construction.

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Table 3- Sri Lanka's long-term generation expansion plan 2005 (Base Case Plan)

YEAR	HYDRO ADDITIONS	THERMAL ADDITIONS	THERMAL RETIREMENTS	LOLP %
2006		-	-	1.081
2007	-	-	-	3.760
2008	-	*200 MW GT part of Kerawalapitiya Combined Cycle Plant*	-	2.792
2009	-	*100 MW ST part of Kerawalapitiya Combined Cycle Plant* **245 MW Gas Turbines**	-	0.817
2010	-	**285 MW Gas Turbines**	3x17 MW Gas Turbine at Kelanitissa	0.676
2011	*150 MW Upper Kotmale*	**600 MW COAL STEAM (WEST COAST)**		0.003
2012	-	**300 MW COAL STEAM (WEST COAST)**	20 MW ACE Power Matara	0.002
2013	-	**300 MW COAL STEAM (SOUTH COAST)**	22.5 MW Lakdhanavi Plant 4x18 MW Sapugaskanda Diesel 20 MW ACE Power Horana	0.007
2014	-	**300 MW COAL STEAM (SOUTH COAST)**		0.006
2015	-	**300 MW COAL STEAM (SOUTH COAST)**	60 MW Colombo Power Plant 100MW Heladhanavi Diesel Power Plant at Puttalam 100MW ACE Power Diesel Power Plant at Embilipitiya	0.063
2016	-	**300 MW COAL STEAM (SOUTH COAST)**		0.077
2017	-	**300 MW COAL STEAM (EAST COAST)**	-	0.109
2018	-	**300 MW COAL STEAM (EAST COAST)**	115 MW Gas Turbine 7 at KPS 51 MW Asia Power Plant	0.428
2019	-	**300 MW COAL STEAM (EAST COAST)**		0.675
2020	-	**300 MW COAL STEAM (WEST COAST)** **105 MW GAS TURBINES**	-	0.696
Total PV Cost up to year 2020, **US$ 4,783.9 million** (LKR 476,679.7 million)				

Source: Long-term Generation Expansion Plan, Ceylon Electricity Board, December 2005
LOLP = Loss of Load Probability, a measure of generating system reliability PV= Present Value

The above base case plan is the least-cost plan approved by the CEB for implementation. Accordingly, Sri Lanka's energy mix in the generating system, as stated in the long-term generation expansion plan, would change from the present oil-dominant status to be coal-dominant, as shown in Table 4. The share of hydropower is estimated by CEB to reduce from 40.2% in 2007 to 19.5% by 2020, while coal-fired thermal generation is estimated to reach 70.9% by 2020. Oil-fired thermal generation which accounted for 59.8% of energy input to the grid in 2007, would be phased out and will provide 9.6% of energy by 2020.

Table 4- Generation mix in the Sri Lanka grid (Base Case)

Primary Source	Gross Energy Dispatched to Grid (GWh)				Share of Total Gross Energy in the Grid			
	2007	2010	2015	2020	2007	2010	2015	2020
Hydro	3946	4,464	4,994	4,994	40.2%	36.7%	28.2%	19.5%
Biomass, solar	1	Not included in the long-term plan			Not included in the long-term plan			
Wind	2	Not included in the long-term plan			Not included in the long-term plan			
Oil-fired thermal	5864	7,705	1,009	2,473	59.8%	63.3%	5.7%	9.6%
Coal-fired thermal		-	11,681	18,187	0.0%	0.0%	66.1%	70.9%
Total	9813	12,169	17,684	25,654	100.0%	100.0%	100.0%	100.0%

Source: Long-term Generation Expansion Plan, CEB, December 2005

Policy Initiatives: The **"Energy Policy and Strategies of Sri Lanka",** approved by the Government (published on 10th June 2008) states that "The Government will endeavour to reach a minimum level of 10% of electrical energy supplied to the grid to be from Non-conventional Renewable Energy (NCRE) sources by a process of facilitation, including access to green funding such as CDM. The target year to reach this level of NCRE penetration is 2015."

Mampuri Wind Power Project is a pioneering effort to build the first commercial wind power plant of Sri Lanka, under the small power purchase scheme. Studies have indicated a technical potential of over 20,000 MW of wind power generating capacity in the country, but no wind power plant has been built as yet, except the CEB's 3 MW demonstration facility built in 1999.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

Dispatch procedure:
The Mampuri Wind Power Plant described in this document, according to the Small Power Purchase Agreement already signed with CEB, will be a must-run power plant. This means that all the energy output of the power plant will be purchased and dispatched into the grid by CEB, at all times. CEB is the only buyer of energy, and there are no other users of the energy output of the power plant.

This procedure is already applied to the small hydro power plants operating on similar standardised power purchase agreements, which is to fully dispatch them irrespective of the short-term economics of load dispatch by CEB.

How anthropogenic emissions of GHG will be reduced:
When one unit (kilowatt-hour) of electricity is input to the connected electricity system (ie the national grid of Sri Lanka) by the small scale CDM activity described in this PDD, the Mampuri Wind Power Plant, an equivalent amount of electricity will be cut-back from the marginal generating plant(s) serving the CEB grid at that instant. The marginal generating plant in the CEB is always a thermal power plant using a fossil fuel. Therefore, the avoided energy output from a thermal power plant would result in a reduction of GHG emissions from fossil-fuel burning power plant(s).

With the higher growth rates recorded in the past, and the 20-year forecast published by CEB, thermal plants will continue to be the marginal power plants in the CEB system. Therefore, the Mampuri Wind Power Plant will avoid anthropogenic emissions of GHG throughout its operating life.

However, for the project to materialise, SWPL the project participant has to face a number of barriers and constraints, to which the solutions are both technological and financial.

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Analysis of the small scale CDM project activity for additionality is based on EB 39 Report Annex 10 **Methodological Tool "Tool for the demonstration and assessment of additionality" (Version 05.2)** The additionality of the project activity is analysed below:

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a: Definition of alternatives to the project activity:

Identification of alternatives to the project participant or to similar project developers:

The small scale CDM project is a wind power plant developed under the small power development scheme of Sri Lanka, to sell electricity to the connected electricity system (the national grid). The following are the alternatives to the project activity, that may provide outputs or services comparable with the proposed CDM project activity.

(i) Alternatives available to the project participant (P): Invest on any of the other types of power plant allowed to be developed under the small power development scheme, namely mini hydro, biomass, agricultural and industrial waste, municipal waste, waste heat and wave energy.
(ii) Alternatives available to similar project developers (D) in the private sector: Invest on thermal power plants operating on fossil fuels (diesel, fuel oil and coal), when solicitations are called for such power plants, consistent with the published long-term generation expansion plan stated in Table 3.
(iii) Alternatives available to the electricity utility (U) (the connected electricity system): Invest on large hydroelectric power plants and thermal power plants operating on fossil fuels (diesel and coal), consistent with the published long-term generation expansion plan stated in Table 3.

However, the project participant is eligible to select only the alternatives from (i) above, because, alternatives in (ii) and (iii) are not open for small power developers, and they can only be exercised when there is a solicitation issued by the Ceylon Electricity Board (CEB) for a specific project. No such solicitations for private participation in power generation projects have been announced since year 2004, which has been closed in the same year.

Accordingly, the realistic and credible analysis of alternatives are listed in the Table below where, in accordance with the EB 39 Report Annex 10 **Methodological Tool "Tool for the demonstration and assessment of additionality" (Version 05.2),** the following are noted:

(a) the proposed project activity undertaken without being registered as a CDM project activity, has been considered.
(b) other realistic and credible alternative scenarios to the proposed CDM project activity scenario that deliver outputs with comparable quality, properties and application areas, taking into account, where relevant, examples of scenarios identified in the underlying methodology, have been included
(c) continuation of the current situation (no project activity or other alternatives undertaken) has **not** been included, because the demand for electricity from the connected electricity system (the national grid of Sri Lanka) is increasing rapidly, requiring the electricity generating capacity to be increased every year

The selection process of credible alternatives to the small scale CDM project activity is described in Table 5 below.

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Table 5- Credible alternatives to the Mampuri Wind Power Project

Alternative available to ---->	Alternative Group P							Alternative Group D		Alternative Group U	
	The project participant							Other investors		The utility	
Alternative	P1	P2	P3	P4	P5	P6	P7	D1	D2	U1	U2
Electricity generating technology	Mini-hydro	Wind	Wave	Biomass	Agro & Indus waste	Municipal Waste	Waste Heat	Oil	Coal	Oil	Coal
Open for private investments	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	no
No solicitation required to be issued	yes	yes	yes	yes	yes	yes	yes	no	no	NA	NA
Solicitaions are currently open	NA	NA	NA	NA	NA	NA	NA	no	no	NA	NA
Alternative available for further consideration by the project participant	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**NO**	**NO**	**NO**	**NO**
Technologies currently/previously implemented in the country on SPP scheme	yes	no	no	yes	yes	no	yes	Not considered further			
Unhindered access to resource available	yes	yes	yes	yes	no	no	no				
Identified, as realistic and credible alternatives to the CDM project activity	**YES**	**YES**	**NO**	**YES**	**NO**	**NO**	**NO**				

Identified, credible alternatives to the small scale CDM project are

(1) a mini-hydro power plant
(2) a biomass (grown) power plant

Outcome of Step 1b: The above are the identified realistic and credible alternative scenario(s) to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Sub-step 1b: Consistency with mandatory laws and regulations:

The alternatives to the CDM project activity listed in Table 5 are in compliance with all mandatory applicable legal and regulatory requirements.

Step 2: Investment Analysis

Sub-step 2a: Determination of appropriate analysis method

The CDM project activity and the alternatives identified in Step 1 generate financial or economic benefits other than CDM related income. Therefore, the simple cost analysis (Option I) will not be used. The analysis can then use investment comparison analysis (Option II) or benchmark analysis (Option III).

For the investment analysis of this small scale CDM project, the benchmark analysis (Option III) was selected.

Sub-step 2b: Option III. Application of benchmark analysis

The financial/economic indicator, most suitable for the project type and decision context was selected to be the **equity Internal Rate of Return (equity IRR)**.

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Calculation of the Benchmark equity IRR

The tool provides for different options to establish the benchmark.

(a) Government bond rates increased by a suitable risk premium, as substantiated by an (independent) financial expert or documented by official publicly available financial data: such information is not available in Sri Lanka.
(b) Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects: Such estimates from published sources are not available
(c) A company internal benchmark (weighted average capital cost of the company), a company internal benchmark (weighted average capital cost of the company) consistently used: The project participant's main line of business has been in trade, where the investments are relatively of a short-term nature, and therefore, not comparable with the proposed small scale CDM project activity
(d) Government/official approved benchmark where such benchmarks are used for investment decisions: Sri Lanka does not publish benchmarks for equity IRR.
(e) Any other indicators, if the project participants can demonstrate that the above Options are not applicable and their indicator is appropriately justified: This option was used to establish the benchmark IRR as described below:

Interest rates for secure investments in Government of Sri Lanka long-term Treasury Bonds were reported in January 2009 (the latest available at the time of preparing this PDD) as follows:

Table 6- Sri Lanka long-term treasury bond rates

Period of maturity (years)	2	4	6	8	10
Highest interest rate offered on Treasury Bonds in January 2009	18.54%	18.52%	18.50%	na	17.95%

Source: Central Bank of Sri Lanka

The project participant's (SWPL) Board of directors has resolved, that the Company requires an equity IRR of at least 7% above the long-term treasury bond rate, as a risk premium, to engage in a project with the complexity and risks such as the Mampuri Wind Power Plant.

To further the interest and commitment of the holding company Senok Trade Combine Ltd to the development of renewable energy in Sri Lanka, the Company has resolved to reduce this "hurdle" rate by 2%. Therefore, the benchmark equity IRR for the project participant was established to be 5% above ten-year Treasury Bond rate.

Benchmark equity IRR = 17.95% + 5% = 22.95%

Other financial parameters used in the investment analysis are specific to the project, and described below.

(a) Investment for the Mampuri Wind Power Project

Table 7- Calculation of project costs

Project Cost	**LKR Million**
Project development / implementation	52.53
Infrastructure development	58.62
Equipment price	1,522.10
Project supervision	8.21
Clearing & transport	89.69
Civil works	187.44
Erection	217.16
Transmission and Interconnection	120.75
Consultancy fees	20.00
Other Costs/contingencies	115.58
Total Project Cost	2,392.08

(b) Base Data and Financing Terms

Table 8- Financing terms

Base Data	
Project Cost (LKR million)	2,392
Construction Period (Months)	12
Guaranteed Plant Capacity (MW)	10
Debt (%)	46%
Equity (%)	54%
Term of Agreement (years)	20
Rs/US$ Exchange Rate	115

Financial Parameter	Unit	Value
Investment	Rs. Million	2,392
Exchange Rate	Rs./USD	115
Percentage Debt	%	46%
AWDR	%	11.72%
AWFDR	%	16.92%
AWPLR	%	19.31%
Repayment Period	years	7

AWDR= Average Weighted Deposit Rate, AWFDR=Average Weighted Fixed Deposit Rate
AWPLR = Average Weighted Prime Lending rate

$$\text{Interest rate} = \frac{\text{AWDR} + \text{AWFDR}}{2} + 6.5\% \qquad \text{for 80\% of debt}$$

$$\text{Interest rate} = \text{AWPLR} + 3.5\% \qquad \text{for 20\% of debt}$$

(c) Technical Parameters

Table 9- Technical parameters used in the investment analysis

Technical Parameter	Unit	Value
Turbine Capacity	kW	1250
No of Turbines	Nos.	8
Total Power Plant Capacity	MW	10
Average net plant factor	%	31.55%

Plant factor is also known as capacity factor

(d) Tariff for the sale of electricity to the connected electricity system

Table 10- Tariff for the sale of electricity as stated in the Small Power Purchase Agreement

SPP Tariff (LKR/kWh)	O&M Tariff (yrs 1-20)	2.14
	Annual Escalation	6.50%
	Fixed Tariff (yrs 1-8)	18.66
	Fixed Tariff (yrs 9-15)	7.03
	Fixed Tariff (yrs 16-20)	1.30

Note: Years are counted from the Commercial Operation Date

Sub-step 2c: Calculation and comparison of financial indicators

The inputs to investment analysis are given in Annex 4.

Benchmark equity IRR = 22.95%
Calculated equity IRR (without CER revenues) = 16.91%

Therefore, the small scale CDM project activity is not financially attractive without CER revenues.

Calculated equity IRR (with CER revenues)
at USD 15 per tCO2 = 19.52%
at USD 30 per tCO2 = 22.20%

Sub-step 2d: Sensitivity analysis

Several sensitivity analyses were conducted to examine the robustness of the financial analysis, to variations of a number of critical assumptions. The results are given below in Table 11, followed by the graphic illustration of the results of the sensitivity analysis in Figure 2.

Table 11- Sensitivity of the benchmark to changes in critical parameters in the investment analysis: without CER revenues

Without CER revenues	**One parameter changed at a time**				
Change in Total Project Cost	-5%	-3%	0%	3%	5%
Calculated equity IRR	**19.01%**	**18.13%**	**16.91%**	**15.79%**	**15.10%**
Change in exchange rate (LKR/USD)	110	112	115	120	125
Calculated equity IRR	**18.16%**	**17.66%**	**16.91%**	**15.70%**	**14.56%**
Change in deposit and lending rates (percentage points changed simultaneously in AWDR, AWFDR, AWPLR)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**17.78%**	**17.34%**	**16.91%**	**16.48%**	**16.06%**
O&M escalation in tariff (percentage point changes with respect to the rate applicable for year 2008)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**16.59%**	**16.74%**	**16.91%**	**17.08%**	**17.26%**

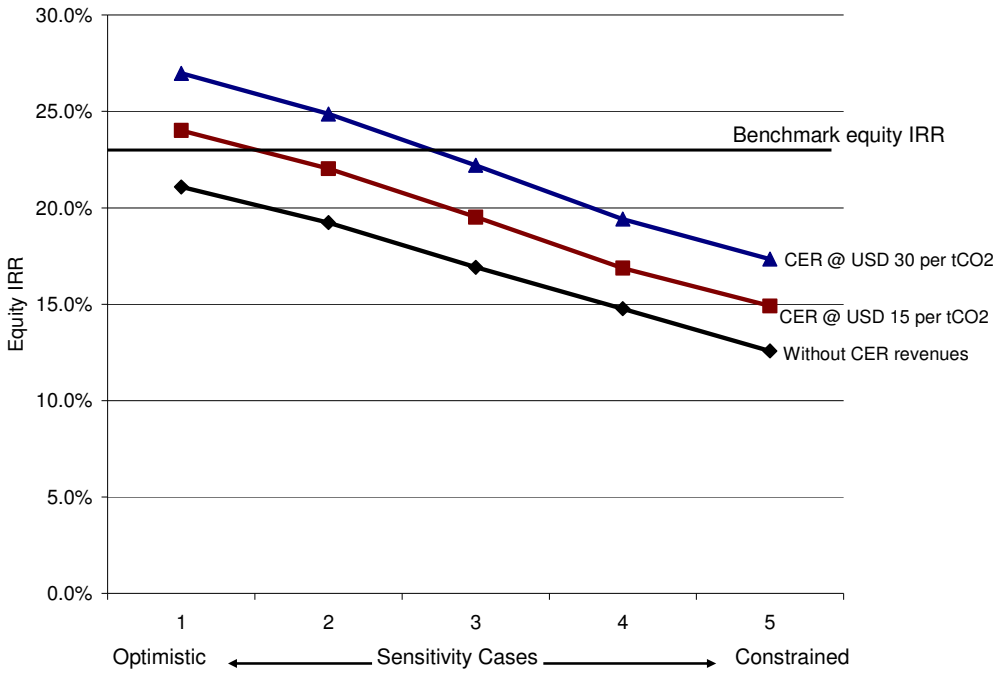
Without CER revenues	**All parameters changed at the same time**				
Change in Total Project Cost	-5%	-3%	0%	3%	5%
Change in exchange rate (LKR/USD)	110	112	115	120	125
Change in deposit and lending rates (percentage points changed simultaneously in AWDR, AWFDR, AWPLR)	-2%	-1%	0%	1%	2%
O&M escalation in tariff (percentage point changes with respect to the rate applicable for year 2008)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**21.08%**	**19.23%**	**16.91%**	**14.76%**	**12.58%**

Table 12- Sensitivity of the benchmark to changes in critical parameters in the investment analysis: with CER revenues

With CER revenues at USD 15 per tCO2	**One parameter changed at a time**				
Change in Total Project Cost	-5%	-3%	0%	3%	5%
Calculated equity IRR	**21.88%**	**20.89%**	**19.52%**	**18.27%**	**17.50%**
Change in exchange rate (LKR/USD)	110	112	115	120	125
Calculated equity IRR	**20.77%**	**20.26%**	**19.52%**	**18.33%**	**17.20%**
Change in deposit and lending rates (percentage points changed simultaneously in AWDR, AWFDR, AWPLR)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**20.44%**	**19.98%**	**19.52%**	**19.06%**	**18.62%**
O&M escalation in tariff (percentage point changes with respect to the rate applicable for year 2008)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**19.23%**	**19.37%**	**19.52%**	**19.67%**	**19.84%**

With CER revenues at USD 15 per tCO2	**All parameters changed at the same time**				
Change in Total Project Cost	-5%	-3%	0%	3%	5%
Change in exchange rate (LKR/USD)	110	112	115	120	125
Change in deposit and lending rates (percentage points changed simultaneously in AWDR, AWFDR, AWPLR)	-2%	-1%	0%	1%	2%
O&M escalation in tariff (percentage point changes with respect to the rate applicable for year 2008)	-2%	-1%	0%	1%	2%
Calculated equity IRR	**24.00%**	**22.02%**	**19.52%**	**16.88%**	**14.91%**

Figure 2- Results of Sensitivity Analysis



Therefore, the small scale CDM project activity "Mampuri Wind Power Project" is unlikely to be financially attractive without revenues from CER.

Step 3: Barrier analysis

The barrier analysis, though optional, is presented to highlight the barriers faced by this pioneering "Mampuri Wind Power Project".

Sub-step 3a: Identification of barriers that would prevent the implementation of the proposed CDM project activity:

(a) Investment barriers

(i) **<u>High magnitude of the project as a private sector renewable energy-based power plant in the context of Sri Lanka, and the small magnitude of the project in the context of the world-wide wind power market</u>:** SWPL requires to face a significant risk owing to the large financial commitment to the project, in comparison with the other private sector investments in renewable energy-based electricity generation in Sri Lanka. Sri Lanka's renewable energy investments less than 10 MW have been opened for private sector investment since 1996, and so far, only two power plants have been built (both are small hydropower plants) with a capacity above 7.5 MW (see Table 13). The investments on such power plants too were lower than the investment envisaged for the Mampuri Wind Power Plant.

Table 13- Renewable energy-based power plants built in Sri Lanka until 2007

Capacity Range	Number of renewable energy-based power plants built by the private sector in Sri Lanka
up to 2.5 MW	47
above 2.5 MW up to 5.0 MW	13
above 5.0 MW up to 7.5	0
above 7.5 MW up to 9.9 MW	2 (small hydro)
Mampuri Wind Power Plant 10 MW	would be the first wind power plant, and the largest investment on a private renewable energy-based power plant in Sri Lanka

Source of information for number of power plants built in each capacity range: Sri Lanka Energy Balance, 2007

Accordingly, from the perception of the private sector in Sri Lanka and the magnitude of projects generally seen in the renewable energy industry, the Mampuri Wind Power Plant represents a significantly higher risk to SWPL in terms of the high magnitude of the investment. A similar risk has been voiced by the lenders to the project. In spite of this risk, SWPL was compelled to rate the power plant to the highest level of 10 MW allowed in Sri Lanka small power development program, to ensure that the project overheads (including the crane), land and transmission line costs would be shared by a larger capacity. Another significant reality in the wind power equipment vendors' market was that the order size was not optimal for them to register their interest in a project of less than 10 MW. Even with a 10 MW project size which is considered very small in a world-wide scale of wind power projects, SWPL had to engage in significant confidence building among the vendors to encourage vendors to quote to provide equipment for the Mampuri Wind Power Project.

(ii) **Limitation of Project Debt:** Prospective lenders to the project, acting as a consortium, have offered to finance the project with a debt capital of LKR 1.1 billion, which is fixed. This results in a debt:equity ratio of 45.5%: 54.5%. Any further depreciation of LKR Vs USD would have to be borne by increased equity infusion to SWPL. Although higher debt:equity ratios were expected and requested from the prospective lenders to the project, the present offer is limited to the above-stated level. All small power projects are expected to enjoy a debt: equity ratio of 60:40, when the standardised tariff offered is calculated and announced. Explanatory notes of the Tariffs for Non-conventional Renewable Energy projects published by the Sri Lanka Sustainable Energy Authority (SEA) state that a debt: equity ratio of 60:40 was expected for a (generic) wind power project. (see www.energy.gov.lk). However, owing to the pioneering nature of the project in the context of Sri Lanka, the lenders have been cautious and offered debt financing only up to 45.5% of the project cost. This increases project financing costs, reducing the project viability.

(iii) **Interest rates offered are higher than tariff assumptions**: The calculations of tariff assumed an interest rate calculated on the basis of AWDR[1] and AWFDR[2], as

1 Average Weighted Deposit Rate

2 Average Weighted Fixed Deposit Rate

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$$\text{Interest rate} = \frac{\text{Average Weighted Deposity Rate} + \text{Average Wighted Fixed deposit Rate}}{2} + 5.5\%$$

The spread assumed in the standardised tariff calculations was 5.5%, but in contrast, the lenders have offered SWPL a spread of 6.5%.

There are two risks to be borne by SWPL, the project participant. One is the fact that the above interest rate used in tariff calculations has been calculated as of the year prior to signing the Small Power Purchase Agreement by SWPL. The SPPA for the Mampuri Wind Power Project was signed in December 2008, while the tariff calculations were based on the calculated interest rates for the six-month period ending December 2007. Since December 2007, the interest rates have significantly risen as shown in Table 14. The increases cause the interest costs to rise, and furthermore, SWPL would be subjected to varying interest rates (repriced monthly), which are not covered in the tariff calculation methodology (Note: The standardised tariff offered to SWPL is based on a fixed interest rate on the debt component of investment, as of the six-month period prior to the year of announcement of the tariff).

Table 14- Movement of interest rates in Sri Lanka compared with the assumptions in the calculation of standardised tariffs to the project

Month	Jan-07	Feb-07	Mar-07	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07
AWDR	7.60%	8.18%	8.26%	8.34%	8.65%	8.86%	9.27%	9.61%	9.65%	9.92%	10.31%	10.31%
AWFDR	11.56%	12.25%	12.28%	12.43%	12.85%	13.16%	13.87%	14.48%	14.53%	15.05%	15.51%	15.49%
AWPLR	15.73%	15.86%	20.01%	18.39%	17.12%	16.20%	16.89%	17.26%	18.95%	17.60%	17.85%	17.95%
Avg of AWDR and AWFDR + 5.5%	15.08%	15.72%	15.77%	15.89%	16.25%	16.51%	17.07%	17.55%	17.59%	17.99%	18.41%	18.40%

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09
AWDR	10.32%	10.45%	10.47%	10.58%	10.76%	10.92%	10.93%	10.91%	11.03%	11.28%	11.39%	11.63%	11.72%
AWFDR	15.51%	15.70%	15.76%	15.89%	16.12%	16.14%	16.28%	16.30%	16.50%	16.48%	16.57%	16.89%	16.92%
AWPLR	18.83%	18.54%	18.61%	17.17%	18.70%	19.07%	18.99%	18.75%	21.19%	20.72%	20.72%	18.50%	19.31%
Avg of AWDR and AWFDR + 5.5%	18.42%	18.58%	18.62%	18.74%	18.94%	19.03%	19.11%	19.11%	19.27%	19.38%	19.48%	19.76%	19.82%

	Loan 1	Loan 2
Interest rate used by SEA/CEB for the calculation of Standardised Tariffs	17.15%	na
Interest rate ofered to Senok Wind Power (Pvt) Ltd by lenders on the basis of latest published interest rates (Jan 2009)	20.82%	22.81%

Secondly, the interest rate as calculated above is offered only to 80% of the debt (Loan 1), while the balance debt (Loan 2) would be at normal commercial rates, calculated as AWPLR[3]+3.5%. The market interest rate that has been so offered by the lenders is therefore 22.81%, based on the latest available published information. This has further increased the project finance costs. The terms offered by the lenders for the two term loans on the above basis, causes the interest rate to increase from 17.15% (assumed in calculating the standardised tariffs offered to SWPL) to 21.22%, which is an increase of over 4%.

(iv) **Higher transmission investments:** The project has an unusually long transmission interconnection cost. There is a medium voltage transmission line of CEB passing within a 2 km distance of the Mampuri Wind Power Plant, with adequate capacity to deliver the output of the power plant to the

[3] Average Weighted Prime Lending Rate

national grid. However, CEB has requested a direct transmission line from the power plant to the gantry at Palavi, and preferably a direct connection to the 33 kV busbar at Palavi. The reasons given for this requirement are (i) CEB is not sure about the impacts of the wind power plant when connected to an existing medium voltage line, as this will be the first such power plant. (ii) The voltage at the point of common coupling may rise because CEB's grid substation 33 kV busbar voltage is always fixed at 33 kV and not varied to match the loading conditions of lines (iii) There are significant outages of the existing CEB line in the area owing to saline pollution and other defects, and the number of line outages experienced per year (2008) was reported to be 180, and such high outage rates will cause major problems to the Mampuri Wind Power Plant. Owing to the above reasons, CEB requested SWPL to build a new medium voltage transmission line from Mampuri to Palavi, a distance of 13 km. If the connection was made to the existing line, the length would have been limited to 2 km. This requirement has caused the project costs to increase beyond what is estimated in the standardised tariff calculations published by the Sustainable Energy Authority and applied to SWPL.

(b) Technological barriers associated with wind power development in Sri Lanka:

(i) **Technological perception and confidence**: The country has only one 3 MW grid connected wind power plant rated at 3 MW, operating at an annual average capacity factor of 17%, located in the southern city of Hambantota. The unit size is 600 kW, with a hub height of 44 m. The power plant was built as a demonstration project by the national utility, CEB. The general perception among the public was that with a 17% annual capacity factor in the demonstration project, wind power was a "failure" in Sri Lanka, and that Sri Lanka "has no wind". Using the wind resource data from ground-based measurements and satellite-based data for the North-western coastal region in a fresh study conducted in 1999-2000, SWPL, the project participant initiated discussions with the Government, Ministry of Power and Energy and Ceylon Electricity Board, to convince the policy makers and the utility that a wind power in the North-western coastal belt was a viable proposition. Subsequently, SWPL developed a feasibility study that indicated a net annual average capacity factor of about 32% for this region using typical industry-standard wind turbines. To obtain such a high annual capacity factor compared with the 17% already provided by the existing pilot project in the south, SWPL conducted a sensitization campaign to explain to the policy makers and the public that the wind climate along Northwest coast is indeed stronger than in the South, and with the use of a higher hub height, larger rotor diameter and improved machine performance, it was possible to achieve an annual average capacity factor of about 32%.

(ii) **Limited technical knowledge and facilities available in Sri Lanka**: There is no wind power equipment manufacture, erection or maintenance services in Sri Lanka, which are essential for a commercial investment such as the Maupuri Wind Power Plant. Accordingly, these services will be procured from India for the erection of the wind power plant. Furthermore, owing to the absence of expertise in maintaining wind power plants in Sri Lanka, SWPL has negotiated with the wind equipment supplier (India-based company) a maintenance agreement for a period of seven years. While such a move adds significantly to the project costs compared with a locally available maintenance facility and expertise, this outsourcing strategy had to be adopted to ensure the reliable operation of wind turbines. The maintenance service provider requires a higher fee, as the Mampuri Wind Power Project is the only wind power project in Sri Lanka, and hence requires to charge all the overhead costs of their Sri Lanka operation to SWPL. This maintenance contract has to be paid for in foreign currency, requiring SWPL to absorb an additional risk of currency depreciation. This is because the maintenance component in the tariff paid by CEB is denominated in Sri Lanka Rupees. SWPL plans to train its own staff during the seven-year period over which maintenance is outsourced, and plans to fully take-over the maintenance of the power plant from the eighth year onwards.

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(iii) **Crane and special transport requirements**: The non-availability of a 400 Ton crane in Sri Lanka to erect the wind turbines is another challenge. While SWPL expected the other three developers in the same siting area to share the cost of the crane, the indications are that they will be significantly lagging behind in the construction schedule, and some projects may not even materialize. The special condition on pricing offered to wind developers under the Small Power Purchase scheme ended in 2008, and only one more developer other than SWPL has signed the power purchase agreement. The Energy Permit issued by the Sri Lanka Sustainable Energy Authority specifies that the Power Plant should be in commercial operation within two years from the date of the Small Power Purchase Agreement. Accordingly, SWPL was compelled to decide to purchase the 400 Ton crane, to ensure that the stipulated timelines of the Government are adhered to, and the project activity enters commercial operation as soon as possible. Addition of a crane to the cost of the 10 MW wind power plant has caused a significant increase in costs, which the project has to bear.

(iv) **Limited availability of ground-based wind flow information and resource assessment expertise**: While SWPL has used the best possible information, and the experts available in Sri Lanka and overseas to ensure that the power plant is optimally matched with the wind regime at Mampuri, it remains a fact that the limited availability of resource information has been a significant handicap to ensuring the long-term optimality of the turbine equipment selection. Thus a significant risk remains to be absorbed by SWPL, the impact of which will only be known after a few years of operation.

Accordingly, the CDM project activity has encountered significant barriers in technological acceptance and know-how particularly in the context of Sri Lanka. Non-implementation of the Mampuri Wind Power Project in the face of the above barriers would cause more emissions of CO_2 from the oil-burning power plants in Sri Lanka national grid, which has been quantified in the relevant section in this PDD.

(c) Barriers due to prevailing practice:

The project activity is the "first of its kind" in Sri Lanka, and according to EB 39 Report Annex 10 **Methodological Tool "Tool for the demonstration and assessment of additionality" (Version 05.2)** no further assessment is presented here on barriers due to prevailing practice.

(d) Organisational Barriers:

SWPL or its holding company Senoka Trade Combine Ltd, or for that matter any state of private company in Sri Lanka, have any previous experience in designing, investing on, building and operating a commercial wind power plant. Therefore, while relying on the best local and international consultants to examine the project technical feasibility, SWPL bears a significant risk in engaging in a project of the magnitude of the Mampuri Wind Power Plant. The reasons for the project to sized at 10 MW were explained earlier, and SWPL would strive to establish an organisational structure capable of ensuring that the technology transfer from this potentially first commercial wind power plant in Sri Lanka would be absorbed and retained with a new organisation structure in the company.

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

As explained in sub-step 1a, the identified, credible alternatives to the small scale CDM project are

(i) a mini-hydro power plant

(ii) a biomass (grown) power plant

An analysis of the impacts of barriers identified in sub-step 3a, on the alternatives listed above, is given below:

Analysis of the impacts of barriers

Barrier identified in sub-step 3a	Description	Alternative 1: mini hydro power plant	Alternative 2: Biomass (grown) power plant	Mampuri Wind Power Plant (the proposed small scale CDM project activity)
Investment barriers	High magnitude of project investment	Projects available in the country for development under the small power scheme are of smaller capacity, hence require lower investment	Power plant can be sized to match the available biomass resource and hence of lower investment	Required to be sized at 10 MW to ensure lower specific investment, thus causing the project investment to be high
	Small magnitude of the project in terms of the worldwide wind power market	Equipment manufacturers have supplied, and continue to supply for power plants of any capacity in the range 100 kW to 10 MW in Sri Lanka	Equipment capacity can be sized to match the resource available and manufacturers would provide the required capacity	The project participant required to size the power plant at 10 MW to attract attention from equipment suppliers, in a worldwide market where the typical size of power plant is 50 MW to 100 MW
	Limitations on the quantum of project debt offered by lenders	Lenders are well acquainted with investments on mini-hydro power, with 64 projects in operation, and hence offer higher debt: equity ratios, up to 80:20	Lenders have financed at least two power plants and hence acquainted with the technology, and are likely to offer higher debt:equity ratios	Lenders have offered limited debt, amounting to a debt:equity ratio of 45.5:55.5, requiring the project participant to absorb 55.5% of the project cost as equity, which is very high in the small power development industry in Sri Lanka.
	Higher interest rates offered by lenders	The spread offered by lenders are lower (in the range of 5.5%) for mature technologies	The spread offered by lenders are lower (in the range of 5.5%) for mature technologies	Lenders have offered a higher spread (6.5%), which has caused the project interest costs to be higher than for other alternatives
	Higher transmission investments	The transmission line is allowed to be connected to the closest point in the 33 kV network in the connected electricity system.	The power plant can be located close to an existing transmission line, and would be allowed to be connected to the closest point in the 33 kV network in the connected electricity system.	Owing to the lack of experience in absorbing wind energy to the grid, CEB has requested the project participant to built a 13 km transmission line to reach the grid, whereas a 33 kV line is available within 3 km from the power plant, to which a connection has not been authorised.

Barrier identified in sub-step 3a	Description	Alternative 1: mini hydro power plant	Alternative 2: Biomass (grown) power plant	Mampuri Wind Power Plant (the proposed small scale CDM project activity)
Technological barriers	Technological perception and confidence	A total of 64 power plants are in operation on commercial basis, and hence the confidence is high	Two power plants are in operation, and hence a moderate confidence level exists.	This will be the first commercial wind power plant in Sri Lanka, in the backdrop of a 3 MW pilot power plant built by the CEB in 1999 which is not performing well.
	Technical knowledge and facilities available in Sri Lanka	All the long-term information and technical services to study, design and build a power plant are available in Sri Lanka	Resource information is available or can be developed, and most of the services are locally available	No construction services are available and required to be procured from abroad
	Crane and special transport facilities	No special requirements and all equipment required for construction and transport are available in Sri Lanka	No special requirements and all equipment required for construction and transport are available in Sri Lanka	Crane has to be especially imported for this project. Special trailers have to be built and an expensive transport operation is required to transport equipment from the port in Colombo to the site in Mampuri
	Limited resource information	Good information on hydro resources and historic data is available	Resource information can be developed through studies, but major uncertainties remain about the biomass availability and a reliable supply-chain	Resource information by way of wind flow measurements at the required height is not available, requiring dependence on estimates using secondary sources.
Barriers due to prevailing practice	Similar types of power plants available	A total of 64 power plants are in operation	Two power plants are in operation	This power plant will be the first of its kind in Sri Lanka.
Organisational barriers	Previous experience	Widespread experience is available in Sri Lanka and within the Group company	Some experience is available in Sri Lanka.	No experience is available in the country to develop a wind power plant, and therefore this is a pioneering effort.
Additionality		**NOT ADDITIONAL**	**NOT ADDITIONAL**	**ADDITIONAL**

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Step 4: Common practice analysis

The proposed small scale CDM project activity is the **first of its kind**, being the first commercial wind power plant in Sri Lanka, developed by the private sector. The only other wind power plant is a 3 MW plant built by the electricity utility in 1999, which used concessionary financing, and had smaller generators.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

AMS-I.D Annex 12 Methodological tool (Version 01.1) "Tool to calculate the emission factor for an electricity system" was used to estimate the emission factor.

Relevant Electric Power System: Sri Lanka's national power system is a stand alone system. It has no interconnection to any other international electricity system. The high voltage transmission network operates at 220 kV and 132 kV. All the generating plants are connected to the national grid, except the community-level micro-power plants and two small power plants serving the mini-grid in the Northern Jaffna peninsula. At grid substations, power at the transmission voltages is converted to 33 kV, which is the sub-transmission voltage. The distribution voltages are 11 kV and 400 V.

The distribution network covers most parts of Sri Lanka. The transmission and distribution network in some areas in the Northern Province has been disrupted during the recent conflicts, while a mini-grid is operated in the Northern Jaffna peninsula. The relevant electric power system for the estimation emission reduction is the **national grid of Sri Lanka**, excluding the Jaffna mini-grid and other smaller community-level mini-grids operating in the country.

The Mampuri Wind Power Plant will be connected by a dedicated 33kV transmission line to the national grid of Sri Lanka. This dedicated 33 kV line is designed to export the entire amount of generated electricity from the power plant to the national grid, and there will be no line capacity constraints. Considering this situation, the **project electricity system** is defined as the spatial extent of the electricity system of the project, from each wind turbine-generator to the metering point. The dedicated 33 kV connection between the project metering point and the national grid will hereafter be identified as the **project transmission line.** The national grid of Sri Lanka will be the **connected electricity system.**

Estimation of the operating margin: The electricity generation share of low cost/must run resources are identified to be some of the hydropower plants in the national grid. The average energy contribution of these power plants are less than 50% of the total generation into the connected electricity system. Therefore, the **simple operating margin** method was selected for the calculation of GHG emissions in the grid to which the electricity from this small-scale CDM activity will be exported. Thereafter, **option A** was used owing to the availability of data for the calculation. Published data is available up to year 2007. Therefore, three years ending in 2007 (2005, 2006 and 2007) were considered for the calculation of the operating margin. The ex-ante calculation method was selected based on the convenience in the monitoring cycles.

Estimation of the build margin: The most-recently built plants feeding the connected electricity system are a few oil-fired thermal power plants, and several small hydroelectric power plants. When the group of the most recently-built plants are considered, small scale grid connected projects (identified as Small Power Producers, SPPs, in Sri Lanka) cannot be excluded, but their contribution of electricity generation to the exporting electricity grid is small (reported capacity and energy contribution of all SPPs developed

since 1996 to the exporting electricity system was 5.0% and 3.5%, respectively, in year 2007). Therefore, the approach of selecting the most recently-built power plants is incapable of capturing the true picture of the exporting electricity grid. Considering this fact, the build margin was calculated by taking the approach of considering 20% of electricity generation contribution to the exporting electricity grid by the most recently-built power plants. Projects which are registered for CDM were excluded from the calculation. The margin of 20% was fulfilled at halfway of the electricity generation of a power pant. The total generation of that power plant was considered for the calculation. All the power plants considered for the calculation of build margin using the approach of 20% of generation, have been built over the period 2003-2007, within the stipulated period of last ten years.

For the vintage of data used for the calculation, option 1 (ex-ante) was used. This means the build margin was estimated based on most recent data at the time of submission of PDD and it will only be subjected to update at the beginning of the second renewable crediting period.

Estimation of the combined margin: The combined margin was calculated according to the guideline stated in Methodological Tool (Annex 12). Weightings of 0.75 and 0.25 for operating and build margins, respectively, were used in the calculation of combined margin. The step by step calculation of the operating margin, build margin and the combined margin emission factors are described in Section B6.3.

B.6.2. Data and parameters that are available at validation:

Data/Parameter:	**Fuel consumption of power plants belonging to Ceylon Electricity Board (CEB) ($FC_{i,m,y}$)**
Data unit:	million litres
Description:	Fuel(s) used for electricity generation in each CEB power plant. Certain power plants use two fuels for operational or economic reasons, and these are separately reported.
Source of data used:	Sales and Generation Data Books (2005, 2006, 2007), Ceylon Electricity Board (CEB)
Value applied:	See Table 19 for values applied for each power plant for each year
Justification of the choice of data or description of measurement methods and procedures actually applied :	The fuel consumption data is required for the calculation of the operating margin. Fuel consumption in each power plant is measured by CEB using fuel flow meters and recorded by power plant staff once every shift (8-hours), and the annual total fuel consumption data is published by CEB in the document "Sales and Generation Data Book". The latest available publication covers the data for year 2007.
Any comment:	Fuel consumption data of CEB is published and is subject to audit both internally and externally. The fuel supplier to all power plants is Ceylon Petroleum Corporation (CPC).

Data / Parameter:	**Fuel consumption of power plants belonging to Independent Power Producers (IPPs) ($FC_{i,m,y}$)**
Data unit:	million litres
Description:	Fuel(s) used for electricity generation in each power plant belonging to IPPs
Source of data used:	Sri Lanka Energy Balance 2007- An Analysis of Energy Sector Performance, Sri Lanka Sustainable Energy Authority
Value applied:	See Table 19 for values applied for each power plant for each year
Justification of the choice of data or description of measurement methods and procedures actually applied :	The fuel consumption data is required for the calculation of the operating margin. Fuel consumption in each power plant belonging to IPPs is measured using fuel flow meters and recorded by the IPP's staff once every shift (8-hours). Sri Lanka Sustainable Energy Authority (SEA) is legally empowered to obtain energy consumption data. Upon request from SEA, the IPPs provide their fuel consumption data annually, which are then compiled and published annually. The latest available publication titled "Sri Lanka Energy Balance" covers the data for year 2007.
Any comment:	All IPPs have a Power Purchase Agreement with CEB, which states the fuel consumption per kilowatt-hour for different operating regimes. Payments by CEB to IPPs are based on fuel price and energy meter readings. IPPs are not obliged to provide the actual fuel consumption data to CEB. Therefore, CEB's Sales and Generation Databook does not carry this information. "Sri Lanka Energy Balance" carries the summary information on fuel consumption of IPPs. Plant-specific information is available in the published Energy Database for year 2007.

Data / Parameter:	**Net electricity generation from power plants belonging to Ceylon Electricity Board ($EG_{m,y}$)**
Data unit:	GWh (Giga-Watthour)
Description:	Electrical energy delivered by each CEB power plant to the connected electricity system ie the national grid of Sri Lanka.
Source of data used:	Sales and Generation Data Books (2005, 2006, 2007), Ceylon Electricity Board (CEB)
Value applied:	See Table 20 for values applied for each power plant for each year
Justification of the choice of data or description of measurement methods and procedures actually applied :	Net electricity generation is required for the calculation of operating margin. Net electricity generation at the point of export from each power plant to the national grid, is measured by CEB using fixed energy meters and recorded by power plant staff once every shift (8-hours), and are published annually by CEB in the document "Sales and Generation Data Book". The latest available publication covers the data for year 2007.
Any comment:	Net electricity generation data is published by CEB annually and is subject to audit both internally and externally.

Data / Parameter:	**Net electricity generation of power plants belonging to Independent Power Producers (IPPs) ($EG_{m,y}$)**
Data unit:	GWh (Giga-Watthour)
Description:	Electrical energy delivered by each power plant belonging to IPPs to the connected electricity system ie the national grid of Sri Lanka.
Source of data used:	Sales and Generation Data Books (2005, 2006, 2007), Ceylon Electricity Board (CEB)
Value applied:	See Table 20 for values applied for each power plant for each year
Justification of the choice of data or description of measurement methods and procedures actually applied :	Net electricity generation is required for the calculation of operating margin. Net electricity generation at the point of export from each power plant to the national grid, is measured by CEB at the end of every month, using fixed energy meters and recorded in the presence of IPP's representatives. This measured information is used by the IPP to raise their monthly invoices to CEB. The information is published annually by CEB in the document "Sales and Generation Data Book". The latest available publication covers the data for year 2007.
Any comment:	None

Data / Parameter:	**Net electricity generation from power plants belonging to Small Power Producers (SPPs) ($EG_{m,y}$)**
Data unit:	GWh (Giga-Watthour)
Description:	Electrical energy delivered by each power plant belonging to SPPs to the connected electricity system ie the national grid of Sri Lanka.
Source of data used:	Sales and Generation Data Books (2005, 2006, 2007), Ceylon Electricity Board (CEB)
Value applied:	See Table 19 for values applied for each power plant for each year
Justification of the choice of data or description of measurement methods and procedures actually applied :	Net electricity generation is required for the calculation of operating margin. Net electricity generation at the point of export from each small power plant to the national grid, is measured by CEB at the end of every month, using fixed energy meters and recorded in the presence of the SPP's representatives. This measured information is used by the SPP to raise their monthly invoices to CEB. The information is published annually by CEB in the document "Sales and Generation Data Book". The latest available publication covers the data for year 2007.
Any comment:	None

Data / Parameter:	**Calorific values of fuel used for power generation ($NCV_{i,y}$)**
Data unit:	kcal/kg (kilo-calories per kilogram)
Description:	The net energy content of a kilogram of each fuel used in thermal power plants for electricity generation
Source of data used:	Sri Lanka Energy Balance 2007- An Analysis of Energy Sector Performance, Sri Lanka Sustainable Energy Authority
Value applied:	See Table 17 for values applied for each fuel used in thermal power plants
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calorific values of fuels used for power generation are required for the calculation of the operating margin. National average net calorific values are published annually by the Sri Lanka Sustainable Energy Authority (SEA).

Any comment:	The conversion factor of 1 kcal= 4.1868 kJ was used to covert the published net calorific value.

Data / Parameter:	**Specific gravity of fuels used for power generation**
Data unit:	kg/l (kilogram per liter)
Description:	This is the density of each fuel
Source of data used:	Sri Lanka Energy Balance 2007- An Analysis of Energy Sector Performance, Sri Lanka Sustainable Energy Authority
Value applied:	See Table 17 for values applied for each fuel used in thermal power plants
Justification of the choice of data or description of measurement methods and procedures actually applied :	The net calorific values of each fuel are required for the calculation. As the published fuel consumption figures are in litres and the published fuel net calorific values are in kCal/kg, the specific gravity of each fuel is required to calculate the total energy input to power plants. National average values of specific gravity are published annually by the Sri Lanka Sustainable Energy Authority (SEA).
Any comment:	None

Data / Parameter:	**Emission Factors of fuel used for power generation**
Data unit:	t-CO2/GJ (Ton of Carbon Dioxide per Giga Joule)
Description:	The emission factors will be used to calculate the operating margin and the build margin
Source of data used:	IPCC Guidelines on National GHG Inventories (2006), Chapter 1 of Volume 2 (Energy)
Value applied:	See Table 17 for the values applied for each fuel
Justification of the choice of data or description of measurement methods and procedures actually applied :	Power plant operators in Sri Lanka do not collect or publish this information. Regional or national average default values, too, are not published. Therefore, IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories was used.
Any comment:	The use of IPCC default values provides a conservative estimate

B.6.3 Ex-ante calculation of emission reductions:

Reference: **AMS-I.D Annex 12- Methodological Tool (Version 01.1) "Tools to calculate the emission factor of an electricity system".**

The "Steps" referred to in the following pages relate to the steps stated in the above Methodological Tool.

Step 1: Identification of the Relevant Electric Power System

The **project electricity system** is the 3.5 km long transmission line operating at 33 kV that interconnects the eight wind turbines that comprise the Mampuri Wind Plant, and the switching and metering equipment located at point of interconnection to the **connected electricity system**.

The **connected electricity system** is the **national grid of Sri Lanka**. There are no transmission constraints between the connected electricity system and the project electricity system. This is because a

new medium voltage transmission line is to be built between the project electricity system and the connected electricity system as a part of the CDM project activity.

DNA of the host country, Sri Lanka, has not published a delineation of the project electricity system and the connected electricity system.

There is only one national grid of Sri Lanka, to which all the major power plants of the utility (Ceylon Electricity Board), the independent power producers and the small power producers are connected. There is a clear demarcation of the national grid, which is entirely owned and operated by Ceylon Electricity Board up to the 33 kV level. The project electricity system and the connected electricity system will be joined by a new 33 kV line. The boundary between the project electricity system and the connected electricity system will be metering point as defined in the Small Power Purchase Agreement already signed between SWPL and Ceylon Electricity Board.

The project electricity system will export electricity at all times when the Mampuri Wind Power Plant is in operation. However, when the wind power plant is shutdown for any reason, there will be electricity imports to meet the basic requirements on the Wind Power Plants such as for use in workshops, offices and perimeter lighting. The estimated imports are 1% of electricity generation. As the electricity imports will be significantly smaller than the exports, no specific method is proposed to assess the CO_2 emissions owing to imports, but emission reductions will be calculated for the net exports, defined as,

Net exports considered for the calculation of emission reductions
= exports to the connected electricity system – imports from the connected electricity system

Step 2- Selection of an Operating Margin (OM) Method

Simple operating margin method: The possibility of using this method was examined by analysing the share of low-cost, must-run resources in the total grid generation, as described below:

The methodological tool requires the last five years to be examined. The most recent five year period for which published data on generation to the national grid is available, is the period 2003-2007. Generation to the connected electricity system (ie the national grid of Sri Lanka) is given Table 15 below.

Table 15- Generation to the National Grid over the most recent five-year period

		Net Generation to the National Grid (GWh)				
Type of Power Plant	**Fuel or resource**	**2003**	**2004**	**2005**	**2006**	**2007**
Hydro, CEB and SPP	Hydro, biomass, solar	3,296	2,944	3,437	5,068	3,930
Thermal, CEB, IPP and hired	Oil	3,844	4,501	5,157	4,595	5,692
Non-conventional, CEB	Wind	3	3	2	2	2
Self generation by customers	Oil	-	115	-	-	-
Total		**7,143**	**7,563**	**8,597**	**9,665**	**9,625**
Percentage of Low cost/must run plants (hydro, biomass, solar, wind)	Annual	46.2%	39.0%	40.0%	52.5%	40.9%
	Simple Average	43.7%				
	Weighted average	43.9%				

Source: Adapted from the Sales and Generation Databook of each respective year
SPP Small Power Producers

CDM – Executive Board

IPP Independent Power Producers

As seen above, the low-cost, must-run resources constitute less than 50% of the total grid generation, when the average of the five most-recent years is considered. Therefore, the simple operating margin method was selected to calculate the operating margin emission factor. Other methods of calculation of the operating margin (simple adjusted, dispatch analysis, average) were therefore not considered further.

The ex-ante option, which uses the three-year generation weighted average based on the most recent data available at the time of submission of the CDM-PDD, was selected to calculate the operating margin emission factor.

Step 3- Calculation of the operating margin emission factor according to the selected method

As the simple operating margin method was selected, the methodological tool provides three options A, B and C to calculate the operating margin. As fuel consumption data is available for each power plant, option A was selected to calculate the operating margin.

In the connected electricity system (the national grid of Sri Lanka), all the generating units in a power plant are either must-run/low-cost units or they are not must-run/low-cost units. In the same power plant, there is no mixing of generating units of two types. Therefore, information used for the calculations are on the basis of power plants and not on the basis of individual generating units within each power plant.

The simple operating margin is the weighted average CO_2 emissions per unit of net electricity generation (tCO2/MWh) of all generating power plants serving the system, excluding the low-cost/must-run units. For this calculation, all the hydroelectric power plants (CEB and Small Power Producers), biomass/wind/solar-based electricity generation (CEB and Small Power Producers) were defined to be low-cost/must-run units, and excluded from the calculation. All the power plants in the grid are listed in Table A3.1, from which, the following two groups of power plants were selected to calculate the simple operating margin emission factor. (a) thermal power plants owned by CEB (b) thermal power plants owned by Independent Power Producers. The data sources used to calculate the operating margin are summarized in Table 16.

Note: As the Chunnakam power plant (8 MW) serves the mini-grid in the northern Jaffna peninsula and therefore not serving the connected electricity system, this power plant was not included in the calculations.

Table 16- Data sources used for the calculation of the operating margin

Data input	Symbol	Data source	Units in which data is published
Amount of fossil fuel consumed by each power plant in each year	FC	Sales and Generation Data Book, Ceylon Electricity Board (2005,2006,2007) and Energy Data 2007, published by Sri Lanka Sustainable Energy Authority	litre
Net calorific value of each fossil fuel type	NCV	Sri Lanka Energy Balance 2007- An Analysis of Energy Sector Performance, Sri Lanka Sustainable Energy Authority	kilocalorie/ kilogram
Specific gravity of each fossil fuel type	sg	Sri Lanka Energy Balance 2007- An Analysis of Energy Sector Performance, Sri Lanka Sustainable Energy Authority	kilogram/litre
Mechanical equivalent of heat	-	standard conversion tables	kilo Joule/ kilocalorie
CO_2 emission factor of each fossil fuel	EF_{CO2}	IPCC Guidelines on National GHG Inventories (2006), Chapter 1 of Volume 2 (Energy)	tonne CO_2/ kilogram
Net electricity generated and delivered to the grid by each power plant	EG	Sales and Generation Data Book, Ceylon Electricity Board (2005,2006,2007)	Giga watthour

NCV for each fuel was first converted from kcal/kg to kJ/litre as follows. The converted values are shown in Table 17.

NCV (kJ/litre) = NCV (kcal/kg) x sg (kg/litre) x mechanical equivalent of heat (4.1868 kJ/kcal)

Table 17- Conversion of fuel calorific values

Fuel Type *i*	Net Calorific value (kcal/kg)	Specific Gravity (kg/litre)	Net Calorific Value (kJ/litre) NCV_i
Fuel Oil	10,104	0.95	40,098
Residual Fuel	10,052	0.97	40,979
Diesel	10,556	0.85	37,391
Naphtha	11,259	0.69	32,510

Note: The published net calorific values are the same for every year over 2005, 2006 and 2007

The methodological tool requires the calculation of the operating margin for the most recent three years for which data is available (ex-ante option) at the time of submission of the CDM-PDD to the DOE for validation, or for each applicable year during monitoring (ex-post option).

The ex-ante option was selected for the calculation of operating margin.

The following equation was used to calculate the simple operating margin.

$$EF_{grid,OMsimple,y} = \frac{\sum_{i,m} FC_{i,m,y}.NCV_{i,y}.EF_{CO2,i,y}}{\sum_{m} EG_{m,y}}$$

CDM – Executive Board

Where:

$EF_{grid,OMsimple,y}$	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,m,y}$	Amount of fossil fuel type i consumed by power plant m in year y (volume unit)
$NCV_{i,y}$	Net calorific value (energy content) of fossil fuel type i in year y (GJ/volume unit)
$EF_{CO2,i,y}$	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
$EG_{m,y}$	Net electricity generated and delivered to the grid by power plant/unit m in year y (MWh)
m	All power plants serving the grid in year y except low-cost/must-run power plants
i	All fossil fuel types combusted in power plant in year y
y	the three most recent years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)

The three most-recent years for which data is available, are 2005, 2006 and 2007. The IPCC default CO_2 emission factors used to calculate the power plant emissions are shown in Table 18. Published fuel consumption for each power plant and the emission estimates are given in Table 19. The published generation from each power plant is shown in Table 20. The operating margin calculations for each year are given in Table 21.

Table 18- IPCC default CO2 emission factors for combustion, used to calculate power plant emissions

Fuel Type *i*	**Emission Factor (kg-CO2/TJ)** $EF_{CO2,i}$
Fuel Oil	75.50
Residual Fuel	75.50
Diesel	72.60
Naphtha	69.30

Source: IPCC Guidelines on National GHG Inventories (2006), Chapter 1 of Volume 2 (Energy)

Table 19- Power plant fuel consumption and calculated emissions in the connected electricity system

Location	Plant Type	Fuel(s) used	Fuel Consumption (million litre) *FC*			Fuel Consumption (TJ) *FC × NCV*			Emissions from Power Plants (t-CO2) *FC × NCV × EF*		
			2005	**2006**	**2007**	**2005**	**2006**	**2007**	**2005**	**2006**	**2007**
CEB Thermal Power Plants											
Kelanitissa	Gas turbine (Old)	Diesel	11.839	3.036	23.742	442,669	113,518	887,731	32,137.8	8,241.4	64,449.3
Kelanitissa	Gas turbine (New)	Diesel	94.249	22.897	73.268	3,524,040	856,136	2,739,545	255,845.3	62,155.5	198,891.0
Kelanitissa	Combined Cycle (Naphtha/diesel)	Diesel	74.595	88.975	126.351	2,789,163	3,326,842	4,724,358	202,493.2	241,528.7	342,988.4
		Naphtha	179.620	91.187	137.586	5,839,407	2,964,469	4,472,891	404,670.9	205,437.7	309,971.3
Sapugaskanda	Diesel	Diesel	1.638	1.855	2.033	61,246	69,360	76,015	4,446.5	5,035.5	5,518.7
		Residual Fuel	75.073	79.055	95.308	3,076,437	3,239,616	3,905,653	232,271.0	244,591.0	294,876.8
Sapugaskanda	Diesel (Extension)	Diesel	1.091	1.255	1.110	40,793	46,925	41,504	2,961.6	3,406.8	3,013.2
		Residual Fuel	113.643	110.070	117.800	4,657,008	4,510,589	4,827,358	351,604.1	340,549.4	364,465.6
IPP Thermal Power Plants: Petroleum											
Lakdanavi	Diesel	Fuel Oil	38.25	25.97	29.14	1,533,630	1,041,346	1,168,457	115,789.0	78,621.6	88,218.5
Asia Power	Diesel	Residual Fuel	81.35	76.75	83.12	3,333,623	3,145,159	3,406,197	251,688.5	237,459.5	257,167.9
Colombo Power (Barge)	Diesel	Fuel Oil	105.17	101.11	102.00	4,217,030	4,054,312	4,090,000	318,385.8	306,100.6	308,795.0
ACE Power Matara	Diesel	Fuel Oil	36.78	29.08	33.24	1,474,645	1,165,850	1,332,819	111,335.7	88,021.7	100,627.8
ACE Power Horana	Diesel	Fuel Oil	37.88	29.01	31.25	1,518,713	1,163,404	1,252,863	114,662.8	87,837.0	94,591.2
AES Kelanitissa	Combined Cycle	Diesel	96.32	163.41	209.40	3,601,402	6,110,022	7,829,622	261,461.8	443,587.6	568,430.6
Heladhanavi	Diesel	Fuel Oil	163.71	140.30	157.64	6,564,570	5,625,754	6,321,054	495,625.0	424,744.5	477,239.6
ACE Power Embilipitiya	Diesel	Fuel Oil	117.94	143.31	160.22	4,729,082	5,746,449	6,424,507	357,045.7	433,856.9	485,050.3
								Total	**3,512,424.7**	**3,211,175.5**	**3,964,294.9**

Table 20- Generation from each power plant in the connected electricity system

Location	Plant Type (additional identification)	Fuel(s) used	Net Electricity Generation (GWh) *EG*		
			2005	**2006**	**2007**
CEB Thermal Power Plants					
Kelanitissa	Gas turbine (Old)	Diesel	20.793	4.431	46.308
Kelanitissa	Gas turbine (New)	Diesel	275.510	65.030	218.792
Kelanitissa	Combined Cycle (Naphtha/diesel)	Diesel	333.717	369.193	550.633
		Naphtha	660.791	340.622	517.641
Sapugaskanda	Diesel	Diesel	3.283	5.189	4.752
		Residual Fuel	314.328	331.418	399.966
Sapugaskanda	Diesel (Extension)	Diesel	2.985	4.022	3.224
		Residual Fuel	505.082	491.258	526.686
IPP Thermal Power Plants: Petroleum					
Lakdanavi	Diesel	Fuel Oil	151.082	103.688	118.422
Asia Power	Diesel	Residual Fuel	353.692	334.203	361.725
Colombo Power (Barge)	Diesel	Fuel Oil	475.780	452.048	456.343
ACE Power Matara	Diesel	Fuel Oil	163.308	129.824	147.708
ACE Power Horana	Diesel	Fuel Oil	174.017	131.778	142.412
AES Kelanitissa	Combined Cycle	Diesel	475.780	619.684	786.885
Heladhanavi	Diesel	Fuel Oil	758.887	619.380	747.740
ACE Power Embilipitiya	Diesel	Fuel Oil	488.219	593.380	663.027
		Total	**5,157.254**	**4,595.148**	**5,692.264**

Table 21- Operating margin emission factor calculations

Year	**2005**	**2006**	**2007**
Emissions from Power Plants (t-CO2)	3,512,424.7	3,211,175.5	3,964,294.9
Net Electricity Generation (GWh)	5,157.254	4,595.148	5,692.264
Simple operating margin CO2 emission factor (t-CO2/MWh)			
Annual (*EF*)	0.6811	0.6988	0.6964
Operating margin emission factor (three-year weighted average) t-CO2/MWh $EF_{grid,OM,2007}$	**0.6921**		

Step 4- Identification of the group of power plants to be included in the build margin

The sample group of power units that have been built most recently can be selected in one of the two methods, as allowed in **AMS-I.D Annex 12- Methodological Tool (Version 01.1) "Tools to calculate the emission factor of an electricity system".**

(a) the five power units that have been built most recently: the five power units built most-recently by end-2007 had a total capacity of 6.9 MW and 17.378 GWh of generation to the connected system. These five power units contributed 0.18% of generation in 2007, as shown in Table 22.

Table 22- Contribution of the five mostly-recently built power units

Five power units most-recently added	Net Generation in 2007 (GWh)
Forest Hill	0.47
Batatota	8.20
Kehelgamu oya	8.19
Kotankanda	0.51
Lower Neluwa	0.00
Total generation	**17.38**
Total grid generation	**9,624.53**
Share of grid generation	0.18%

(b) the set of power plant additions that comprise 20% of system generation (in GWh) and that have been built most recently, was therefore selected to calculate the build margin emission factor. The list of power plants is given in Table 23. Power plants were ranked from the most recent, and its electricity generation in 2007 was calculated cumulatively. It was observed that with the inclusion of AES Kelanitissa power plant, the share of generation covered exceeded 20%. All the power plant selected are less than ten years old, and satisfy the condition stated in the Methodological Tool.

Table 23- Selection of the set of power plant additions that comprise 20% of generation

			Generation in 2007 (GWh)	Cumulative % of total generation covered
	Total generation in the connected electricity system		**9,624.527**	**100.0%**
	Power Plant	**Year of addition (most-recent plant first)**		
1	Small Power Producers	Jan-Dec 2007	16.899	0.2%
2	Small Power Producers	Jan-Dec 2006	46.396	0.7%
3	ACE Power Embilipitiya	Mar 2005	663.027	7.5%
4	Small Power Producers	Jan-Dec 2005	34.412	7.9%
5	Heladhanavi	Oct 2004	747.740	15.7%
6	Small Power Producers	Jan-Dec 2004	94.461	16.7%
7	AES Kelanitissa	Oct 2003	786.885	24.8%
	Power Plants excluded from build margin estimates			
	Kukule	Jul 2003	267.256	27.6%
	other power plants	before July 2003		

Data sources:

1. Small Power Producer commissioning dates from “Sales and Generation Data Book”
2. Other power plant commissioning dates from “CEB Long-term Generation expansion Plan”.
3. Generation in 2007 from each power plant from “Sales and Generation Data Book 2007”.

Note: The following Small Power Plants that have been registered as CDM project activities were excluded from the list of power plants selected in Table 23 to calculate the build margin.

Name of Power Plant	Commissioning Year	Reference Number
Hulu Ganga 2	2006	0085
Delta Estate	2006	0751
Badalgama	2005	2364
Alupola	2004	0100

There are four other registered CDM project activities in the host country serving the connected electricity system (Sri Lanka national grid), but they do not belong to the group of power plants added to the connected electricity system between years 2004 and 2007.

Step 5- Calculation of the build margin emission factor

The build margin CO2 emission factor was calculated for year 2007, the most recent year for which data is available. Emission factors for used for each fuel were the same as for the calculation of operating margin in step 3. The following equation was used. Results of the calculation are shown in Table 24.

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available (in this case y = 2007)

Table 24- Calculation of the build margin emission factor

	Power Plant	Fuel Type	Fuel consumption in 2007 (TJ)	Emissions (t-CO2) *EG* ×*EF*	Generation (GWh) *EG*
1	Small Power Producers	small hydro	none	none	16.899
2	Small Power Producers	small hydro	none	none	46.396
3	ACE Power Embilipitiya	Fuel Oil	6,424,507.2	485,050.3	663.027
4	Small Power Producers	small hydro	none	none	34.412
5	Heladhanavi	Fuel Oil	6,321,054.3	477,239.6	747.740
6	Small Power Producers	small hydro	none	none	94.461
7	AES Kelanitissa	Diesel	7,829,622.0	568,430.6	786.885
	Total in power plants considered for the build margin			1,530,720.5	2389.820
	Build margin emission factor (t-CO2/MWh) $\mathbf{EF_{grid, BM, 2007}}$			**0.6405**	

Note: Numbers in the first column refer to the numbers in Table 23.

Step 6- Calculation of the combined margin emission factor

The methodological tool **AMS-I.D Annex 12 Methodological tool (Version 01.1) "Tool to calculate the emission factor for an electricity system"** used in this analysis requires the combined margin to be calculated as the weighted average of the operating margin emission factor and the build margin emission factor.

The combined margin emissions factor was calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y (tCO_2/MWh)
w_{OM}	Weighting of operating margin emissions factor (%)
w_{BM}	Weighting of build margin emissions factor (%)

As the Mampuri Wind Power Plant is a wind power generation project activity, in accordance with the methodological tool, the weighting factors used for operating margin and build margin requires to be w_{OM} = 0.75 and w_{BM} =0.25, respectively, and the results are shown in Table 25.

Table 25- Calculation of the combined margin emission factor

Emission Factors	Calculated value t-CO2/MWh *EF*	Weighting factor *w*	Weighted Margin t-CO2/MWh
Operating margin	0.6921	0.75	0.5191
Build margin	0.6405	0.25	0.1601
Combined Margin $EF_{grid,CM,y}$			**0.6792**

Therefore, emission reductions in the first creditin period of seven years was estimated to be the following:
Emission reduction = Combined margin (t-CO2/MWh) × Electricity Generation (MWh) × No. of years

Total emission reduction for a period of seven years = 0.6792 × 27,638 × 7
= 131,397 t-CO2

B.6.4 Summary of the ex-ante estimation of emission reductions:

Value for the operating margin emission factor $EF_{grid,OM,y}$ = 0.6921 t-CO2/MWh
Value for the build margin emission factor $EF_{grid,BM,y}$ = 0.6405 t-CO2/MWh
Value for the combined margin emission factor $EF_{grid,CM,y}$ = 0.6792 t-CO2/MWh

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**Gross Energy Sales to Ceylon Electricity Board**
Data unit:	kilo-watthour
Description:	This will measure the energy output to the national grid from the Project
Source of data to be used:	Export register of the energy meter installed at the Point of Supply (POS) to the national grid
Value of data	As recorded in the energy meter (M1)
Description of measurement methods and procedures to be applied:	The energy meter will be installed and maintained by Ceylon Electricity Board in accordance with the Small Power Purchase Agreement. The meter (M1) will be read by CEB every month, in the presence of the SWPL representative.
QA/QC procedures to be applied:	The accuracy of the meter is declared to be 2%. The meter accuracy will be tested (ie the meter shall be calibrated) by an independent agency, once a year, as specified in the Small Power Purchase Agreement. If at any time there is a concern about the accuracy, SWPL or CEB can request a test.
Any comment:	As a backup to the energy meter installed by CEB for contractual purpose, an additional meter (M1B) will be installed in the power plant at the expense of SWPL. This meter too, will be calibrated annually by SWPL using the services of an independent agency.

Data / Parameter:	**Energy purchased from Ceylon Electricity Board**
Data unit:	kilo-watthour
Description:	This will measure the energy purchased from the national grid to satisfy the requirements of the Project. These requirements would generally be the requirements for lighting, transformer energisation and workshops, when the power output of wind turbines is low and inadequate to meet the requirements.
Source of data to be used:	(1) Import register of the energy meter installed at the Point of Supply (POS) to the national grid (2) energy meter installed at the point of purchase of electricity from a local distribution line.
Value of data	As recorded in the respective energy meters (M2 and M3)
Description of measurement methods and procedures to be applied:	(1) The energy meter at the POS will be installed and maintained by Ceylon Electricity Board in accordance with the Small Power Purchase Agreement. The meter (M2) will be read by CEB every month, in the presence of the SWPL representative. (2) The energy meter at the point of purchase will be installed by Ceylon Electricity Board. This meter (M3) will be read by CEB every month.
QA/QC procedures to be applied:	The accuracy of the meters is declared to be 2%. (1) The accuracy of the meter M2 will be tested (ie the meter shall be calibrated) by an independent agency, once a year, as specified in the Small Power Purchase Agreement. If at any time there is a concern about the accuracy, SWPL or CEB can request a test. (2) The accuracy of meter M3 can be tested by CEB, upon request by SWPL, in CEB's own meter testing laboratory
Any comment:	As a backup to the energy meter M2 installed by CEB for contractual purpose, an additional meter (M2B) will be installed in the power plant at the expense of SWPL. This meter too, will be calibrated annually by SWPL using the services of an independent agency.

B.7.2 Description of the monitoring plan:

The monitoring shall consist of metering the electricity exported and imported by the power plant to/from the connected electricity system, the national grid of Sri Lanka. More details are given below.

(1) Boundaries for the implementation of the monitoring plan

The monitoring plan will be implemented across the project boundary. The project boundary is described in section B3 of this PDD.

(2) Data collection and recording

(a) Electricity Exports and Imports: An electricity meter will be fixed at the metering point located at the interconnection point to the CEB grid. This is a requirement specified in the Small Power Purchase Agreement (SPPA) already executed between SWPL and CEB. The meter will measure electricity dispatched to the grid at the project boundary. This meter will be of the type and accuracy approved by CEB, and the SPPA states that it will be read by CEB once a month. This is an

established practice for CEB to read the meters of all the small power producers in the country once a month. This meter reading will be in two parts:
M1: Electricity exports to the connected electricity system from the small scale CDM project activity
M2: Electricity imports from the connected electricity system for requirements of the project activity, when the wind power plant is not in operation

Reading M1 will also be used by SWPL to prepare the monthly invoice to the purchaser, CEB for the sale of electricity.
Reading M2 will also be used by CEB to issue an invoice for the electricity purchased by the project activity, when the wind power plant is not in operation

M1 and M2 are usually incorporated in the same meter housing. There will be a second meter located elsewhere, as described below.

M3: This meter fixed by CEB will record the electricity purchased by this small scale project activity from the local distribution line. This electricity supply is a backup to serve the project, when there is a breakdown or servicing of the equipment at the point of supply at which M1 and M2 are located.

(b) **Community Social Responsibility (CSR) Activities**: SWPL, the project participant, will spend not less than USD 2500 every year on community development projects in Mampuri and the surrounding villages. There will be three specific projects, implemented through existing community organisations explained below. All the three projects would be implemented within the first three years of the crediting period. Thereafter, not less than USD 2500 will be spent on the maintenance and upkeep of all the three CSR actitivites.

b.1 Midwife's clinic

CSR Activity:	Construction of the building
Location:	Daluwa village
Implemented through:	Daluwa-Nirmalapura Subasadhana Samithiya (Welfare Society)

b.2 Montessori (Nursery) school

CSR Activity:	Construction of the building
Location:	Narakkalliya village
Implemented through:	Narakkalliya Subasadhana Samithiya (Welfare Society)

b.3 Playground

CSR Activity:	Upgrading the playground
Location:	Narakkalliya village
Society:	St. Sebestians Sports Club

These CSR activities will be monitored by the respective Society/Club. For the construction of facilities, a certificate from a Chartered Engineer of the Institution of Engineers Sri Lanka with a priced bill of quantities attached, along with a certificate from the Grama Seva Niladhari or the

Chairperson/Treasurer of the respective Society/Club would form the data requirements for the monitoring plan.

The following Table 26 describes the basic format for data collection. More detailed forms are given in Annex 5.

Table 26- Basic Format for Data Collection

Project name: **Mampuri Wind Power Plant, Sri Lanka** Project Company: **Senok Wind Power (Pvt) Ltd.(SWPL)**

Period	Monitored performance	Monitoring devise or method	Back-up data sources	Unit of measure-ment	Monitoring frequency	All information to be monitored	Method to archive data	Period of retention of archived data	Comments
MM-YYYY	Net electricity exported to the national grid	Electricity meter readings Gross export = M1 Imports = M2 + M3 Net export = M1 – (M2+M3)	(1) Additional meter fixed at the metering point (M1B and M2B) (2) Hourly power (kW) output readings for each wind turbine (P1 to P8) recorded at the power plant Central Monitoring Station	kilowatt-hour (kWh)	CEB-owned meters: monthly SWPL-owned meters: daily See note 1	Yes	Electronically and manually	Two years after the last CERs issued	CEB publishes the monthly and annual total energy of each power producer in its annual publication "Sales and Generation Data Book"
MM YYYY	CSR activity implemented	Annual progress report by Senok Wind Power Pvt) Ltd., certified by Chartered Engineer and relevant village/society chairperson/treasurer	(1) Monthly progress reports by Senok Wind Power (Pvt) Ltd. (2) Interviews of office bearers and beneficiaries of the CSR activity	% Progress achieved, funds disbursed	Annually	Yes	Electronically and manually	Two years after the last CERs issued	

Note 1: The primary data source M1, M2 and M3 owned by CEB will be recorded monthly
The first backup data source M1B, M2B owned by SWPL will be recorded daily
The second backup data source P1 through P8 will be recorded by SWPL hourly

Note 2: If there is an error in M1, M2 or M3, SWPL will request CEB to recalibrate the meter, for which a procedure is stated in the power purchase agreement.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completion of the application of baseline and monitoring methodologies: 15th April 2009

Name of responsible person and entity:
Dr Tilak Siyambalapitiya
Director
RMA (Pvt) Ltd
3, Charles Terrace
Colombo 3
Sri Lanka.

RMA (Pvt) Ltd is the Sri Lankan consulting company, and not a party connected to Senok Wind Power (Pvt) Ltd., the project participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

1st October 2009

C.1.2. Expected operational lifetime of the project activity:

Twenty years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

1st October 2009

C.2.1.2. Length of the first crediting period:

Seven years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable as renewable crediting period was selected

C.2.2.2. Length:

Not relevant

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

As required by Sri Lanka's environmental regulations, an application was made to the Provincial Environmental Authority of the North-Western Province (PEA-NWP) where the Mampuri Wind Power Project is located. As the project lies within the coastal zone, the evaluation of the project for its environmental impacts was conducted by the Coast Conservation Department (CCD) acting as the Project Approving Agency, with the participation of all stakeholder institutions. As required by the CCD, an Initial Environmental Examination (IEE) study was conducted (September 2008) and submitted. The approval of both the CCD and the PEA-NWP were issued for the project to proceed to construction activities.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Project participant, Senok Wind Power (Pvt) Ltd, does not consider the environmental impacts to be significant. The host party, represented by the PEA-NWP and CCD has not indicated that the project environmental impacts would be significant, in which case, a full Environmental Impacts Assessment (EIA) would have been required to be conducted in accordance with the laws. The approval for the project was granted based on the IEE.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

During the initial stages of project development, several informal meetings with small groups of about five local stakeholders were held, and their views were sought about the planned project. Stakeholders of the project in the local area include land owners in the vicinity of the project, fishermen and others using the beach adjoining the plant, villagers in Mampuri and other villages to north and south of the power plant site, community and religious leaders and government officials. Information was provided about the benefits and the probable constraints caused by the project at a very early stage of project development, to allow the local stakeholders time to think about the issues, consider implications, and formulate their views.

A formal public consultation meeting by the three wind project developers who have been allocated blocks at Mampuri (Senok Wind Power Pvt Ltd), Narakkalli (Lanka Transformers Ltd) and Nirmalapuru (Hayleys Ltd) was held at 10.00am at on 15th December 2007, at the Mampuri Church with the coordination of SEDEC and Mampuri Catholic Priest Reverend Father Viamon. SEDEC is a community service organisation, affiliated to the Catholic Church of Sri Lanka. The meeting was organized by SEDEC and Father Viamon based on the request jointly made by the three developers. One week's notice was given to all the stakeholders. Invitations were sent by the Catholic Church to Buddhist Priests, Muslim Priests, Hindu Priests of the area, the Kalpitiya Divisional Secretary, Pradesiya Sabha Chairman, Govi Kamitu (Agrarian Community), Dheewara Kamitu (Fisheries Community) and the villagers of Mampuri, Daluwa. The meeting was attended by 30 persons.

Information was sufficiently provided in accessible and culturally appropriate ways. Written information was distributed in all the three languages, Sinhala, Tamil and English. A formal presentation covering specific locations of wind turbines, equipment sizes, foundation details, turbine height, blade sizes, noise

that it can generate, power it generates, installation procedure of turbines and our path forward in the project development and subsequent operation and maintenance was made to the audience. Each issue in the presentation and was discussed in detail, including questions raised by the stakeholders throughout the presentation.

E.2. Summary of the comments received:

The following questions were raised during the meeting:

Questions directly related to the project (*text in italics are clarifying notes*)

(a) What are the possible effects on beach seine (*Sinhala: Ma-del*) operation?
(b) What will be the operation during off wind season? What is the gain by installing wind farms for only wind seasons?
(c) Will there be a huge noise due to many turbines in the area?
(d) Will it be similar to the power station (*oil-fired)* located in Puttalam suburbs?
(e) What is the land utilization pattern and extent of lands to be used by the wind farm(s)?
(f) Will there be forceful acquisition of lands as what the government does with the coal power project (*planned to be located in Narakkalli, to the north of Mampuri)*?
(g) What improvement will be done for the roads in the project areas?
(h) Will there be additional transmission lines constructed in the area?
(i) Why does the project use 1.25 turbines? Why not 5MW *(to reduce the land area used*)?
(j) What is the effect to ground water once the turbine foundations are constructed? Will there be water depletion in the area?
(k) The water table is found 6-7m below the ground level. When the foundations are constructed, will it stop the ground water movement in the area?

Questions related to the coal-fired power plant proposed to be built by Ceylon Electricity Board, to the north of Mampuri.

(l) Is this a part of coal power station expansion? Are these fans constructed to pull down the coal power emission to the ground once again to prevent them dispersing in the area?
(m) Why the Kandikudi area is not been utilized for wind farms? You out do the coal power station and bring wind farms if not go and install wind turbines in Kandikudi area (*to the north of Mampuri*).
(n) Can the coal power capacity be matched with wind farms?

E.3. Report on how due account was taken of any comments received:

(a) Impacts on beach seine (*Sinhala: Ma-del*) operation

A group of fishermen use a long seine (net, made of locally available material) on the beach, and pull it about 50 m inland from the beach over a period of several hours, and catch fish. The group moves along the beach parallel to the waterline as well and perpendicular, moving about 50 m in land as required.

The project will ensure the no wind turbine locations or any material and equipment during construction and operation will be located within 50 m from the waterline on the beach.

(b) Operation in the off-wind season: The measured wind patterns were explained to the stakeholders, and clarified that in the low wind season too, there will be generation of electricity.

(c) Will there be a huge noise due to many turbines in the area?

The expectation of noise and type of noise was explained to the stakeholders. The power plant will abide by the noise regulations stipulated by the Central Environmental Authority and the Provincial Environmental Authority.

(d) Will it be similar to the power station (*oil-fired)* located in Puttalam suburbs? The differences in technological and social/environmental impacts between an oil-fried power plant and a wind power plant were explained.
(e) What is the land utilization pattern and extent of lands to be used by the wind farm(s)? The land requirements, and the fact that only the turbine footings will be allocated to SWPL. and that the area between the turbines will be freely accessible to the people, were clarified.
(f) Will there be forceful acquisition of lands as what the government does with the coal power project (*planned to be located in Narakkalli, to the north of Mampuri)*? It was clarified that there will be no relocation of people or forceful acquisition of government land to the project. The land will be allocation through the proper procedure (for government land) and by direct negotiation with owners (for private land). *Note: By the time of submission of this PDD all land requirements to the project have been allocated.*

(g) What improvement will be done for the roads in the project areas?

The project, at its cost, will improve the coastal road running through or adjacent to the project site, with compaction and increase of the width. It is presently not compacted and difficult to use. The road will be freely accessible and useable by the public during the project construction and operation, and will be developed in accordance with the guidelines given by the Kalpitiya Pradeshiya Sabha (the local authority that is responsible for the road).

(h) Will there be additional transmission lines constructed in the area? It was clarified that there will be new 33 kV line along the land-side of the wind turbines, and a new 1.5 km transmission from the point of supply along a local road to the main road. The line will enable CEB to use the structure to provide any distribution services to households/business premises, which may have been deprived of electricity supply owing to the absence of a line.
(i) Why does the project use 1.25 turbines? Why not 5MW *(to reduce the land area used*)? The principles in which a wind turbine is selected to match a wind regime was explained.

(j) What is the effect to ground water once the turbine foundations are constructed? Will there be water depletion in the area? AND

(k) The water table is found 6-7m below the ground level. When the foundations are constructed, will it stop the ground water movement in the area?

The levels at which groundwater is available at the power plant site were explained. With the large (approximately 500 m) gap between turbine foundations, impacts on groundwater flow are not expected. The project will monitor the groundwater levels during construction and periodically thereafter, to examine that the levels and quantity of groundwater are not affected by the turbine foundations.

Questions not directly related to the project: The technical issues were explained, and it was explained that the project is comparatively small (10 MW) compared with the 900 MW coal-fied power plant being

built to the north of Mampuri, and that the two projects are not comparable in terms of providing the electricity needs of Sri Lanka.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Senok Wind Power (Pvt) Ltd.
Street/P.O.Box:	No 3, R A de Mel Mawatha
Building:	------
City:	Colombo 5
State/Region:	------
Postfix/ZIP:	0050
Country:	Sri Lanka
Telephone:	+94-11- 259 3343
FAX:	+94-11- 258 0022
E-Mail:	info@senoksl.com
URL:	http://www.senoksl.com
Represented by:	
Title:	Director - Finance
Salutation:	Mrs
Last Name:	Dias
Middle Name:	------
First Name:	Pancherine
Department:	------
Mobile:	+94-77- 279 9003
Direct FAX:	+94-11- 451 2122
Direct tel:	+94-11- 250 6560
Personal E-Mail:	dias@senoksl.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

The Mampuri Wind Power Project will not use any public funding.

Annex 3
BASELINE INFORMATION

Generating plants serving the national grid of Sri Lanka (the connected electricity system of the small scale project activity described in this PDD) as of end December 2007 are listed in Table A3.1.

Table A3.1- Generating plants serving the national grid of Sri Lanka, as of December 2007

hydroelectric power plants

Plant Name	Units x Capacity (MW)	Capacity (MW)	Annual Avg. Energy under average hydrological conditions (GWh)
Laxapana Complex			
Canyon	2 x 30	60	160
Wimalasurendra	2 x 25	50	112
Old Laxapana	3 x 8.33+2 x 12.5	50	286
New Laxapana	2 x 50	100	552
Polpitiya	2 x 37.5	75	453
Laxapana Total		**335**	**1563**
Mahaweli Complex			
Victoria	3 x 70	210	865
Kotmale	3 x 67	201	498
Randenigala	2 x 61	122	454
Ukuwela	2 x 20	38	154
Bowatenna	1 x 40	40	48
Rantambe	2 x 24.5	49	239
Mahaweli Total		**660**	**2258**
Other Power Plants			
Samanalawewa	2 x 60	120	344
Kukule	2x35	70	300
Small hydro (Inginiyagala, Uda walawe, Nilambe)		20	
Total other power plants		**210**	
Total in operation		**1205**	**4465**
Under construction			
Upper Kotmale (due for commissioning in 2010)	2 x 75	**150**	409

Thermal power plants owned by CEB

Plant Name	**Units x Name Plate Capacity**	**Capacity (MW)**	**Annual Max. Energy (GWh)**
Kelanitissa Power Station			
Gas turbine (Old)	4 x 20	80	417
Gas turbine (New)	1 x 115	115	707
Combined Cycle (Naphtha/diesel)	1 x 165	165	1290
Kelanitissa Total		**360**	**2414**
Sapugaskanda Power Station			
Diesel	4 x 20	80	472
Diesel (Ext.)	8 x 10	80	504
Sapugaskanda Total		**160**	**976**
Small Thermal Plants			
Chunnakam	1 x 8	8	-
Small Thermal Total		**8**	**-**
Existing Total Thermal		**528**	**3390**

Thermal power plants owned by independent power producers

Plant Name	Capacity (MW)	Minimum Guaranteed Energy (GWh)
Lakdanavi	22.5	156
Asia Power	51	330
Colombo Power (Barge)	64	420
ACE Power Matara	24.8	167
ACE Power Horana	24.8	167
AES Kelanitissa	163	1314
Heladhanavi	100	698
ACE Power Embilipitiya	100	697
Total IPP	**550.1**	**3949**

Small Power Plants (SPPs) using renewable energy

	Name of Power Plant	Contracted Capacity	Year of Commercial Operation	Installed Capacity (MW)												Generaion in 2007 (GWh)		
				1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	Non-CDM projects	CDM projects	CDM Ref number
1	Dick Oya	0.96	1996	1.40	1.50	2.40	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	3.638		
2	Seetha Eliya	0.11	1996				0.11	0.11	0.11	0.11	0.11	0.07	0.07	0.07	0.07	0.033		
3	Ritigaha Oya	0.11	1997				0.11	0.11	0.11	0.11	0.80	0.80	0.80	0.80	0.80	2.481		
4	Talawakelle	0.11	1997				0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.000		
5	Rakwana Ganga	0.76	1999				0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	1.242		
6	Kolonna	0.78	1999				0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	1.805		
7	Ellapita Ella	0.56	1999				0.56	0.56	0.56	0.56	0.56	0.55	0.55	0.55	0.55	2.101		
8	Carolina	2.02	1999				2.02	2.02	2.02	2.02	2.02	2.50	2.50	2.50	2.50	11.686		
9	Weddamulla	0.20	1999				0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.111		
10	Madampe(Waste heat)	0.39	1999				0.39	0.39	0.39	0.39	0.39	0.39	0.10	0.10	0.10	0.000		
11	Delgoda	2.91	2000					2.91	2.91	2.91	2.91	2.65	2.65	2.65	2.65	9.947		
12	Mandagal Oya	1.28	2000					1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	4.066		
13	Glassaugh	2.56	2000					2.56	2.56	2.56	2.56	2.53	2.53	2.53	2.53	9.367		
14	Minuwnella	0.64	2001						0.64	0.64	0.64	0.64	0.64	0.64	0.64	1.801		
15	Kabaragala	1.50	2001						1.50	1.50	1.50	1.50	1.50	1.50	1.50	3.833		
16	Bambarabatu Oya	3.20	2001						3.20	3.20	3.20	3.20	3.20	3.20	3.20	10.219		
17	Galatha Oya	1.20	2001						1.20	1.20	1.20	1.20	1.20	1.20	1.20	3.070		
18	Hapugastenna I	4.80	2001						4.80	4.80	4.80	4.89	4.60	4.60	4.60	16.088		
19	Belihuloya	2.50	2002							2.50	2.50	2.50	2.50	2.50	2.50	7.679		
20	Watawala	1.30	2002							1.32	1.32	1.30	1.30	1.30	1.30	4.765		
21	Niriella	3.00	2002							3.00	3.00	3.00	3.00	3.00	3.00	5.394		
22	Hapugastenna II	2.40	2002							2.40	2.40	2.40	2.30	2.30	2.30		15.696	85
23	Deyianwala	1.50	2002							1.50	1.50	1.50	1.50	1.50	1.50	2.712		
24	Hulu Ganga 1	2.88	2003								2.88	3.00	3.00	3.00	3.00	0.000		
25	Sanquhar	1.60	2003								1.60	1.60	1.60	1.60	1.60		3.083	751
26	Karawila Ganga	0.75	2004									0.75	0.75	0.75	0.75	2.366		
27	Brunswic	0.60	2004									0.60	0.60	0.60	0.60	0.347		
28	Sithagala	0.80	2004									0.80	0.80	0.80	0.80	2.130		
29	Way Ganga	8.93	2004									8.93	8.93	8.93	8.93	16.301		
30	Alupola	2.52	2004									2.52	2.52	2.52	2.52		8.962	100
31	Rathganga	2.00	2004									2.00	2.00	2.00	2.00	9.613		
32	Waranagala	9.90	2004									9.90	9.90	9.90	9.90	40.160		
33	Nakkawita	1.01	2004									1.01	1.01	1.01	1.01	0.027		
34	Walakada	4.21	2004									4.21	4.21	4.21	4.21	13.999		
35	Nianwita Oya	0.60	2004									0.60	0.60	0.60	0.60	2.048		
36	Atabage Oya	2.21	2004									2.21	2.35	2.35	2.35	7.222		
37	Batalagala	0.10	2004										0.10	0.10	0.10	0.109		
38	Battaramulla(Solar Power)	0.02	2004					0.10	0.10	0.10	0.10	0.02	0.02	0.02	0.02	0.000		
39	Walapane(Dendro)	1.00	2004									1.00	1.00	1.00	1.00	0.139		
40	Hemingford	0.18	2005										0.18	0.18	0.18	0.436		
41	Kotapola	0.60	2005										0.60	0.60	0.60	1.436		
42	Wee Oya	3.00	2005										3.00	3.00	3.00	14.137		
43	Radella	0.20	2005										0.20	0.20	0.20	0.500		
44	Kumburuteniwela	2.80	2005										2.80	2.80	2.80	4.187		
45	Asupini Ella	1.30	2005										1.30	1.30	1.30	7.013		
46	Kalupahana	0.80	2005										0.80	0.80	0.80	1.871		
47	Upper Korawaka	1.50	2005										1.50	1.50	1.50	4.832		
48	Badalgama (Biomass)	1.00	2005										1.00	1.00	1.00		1.119	2364
49	Delta Estate	1.20	2006											1.20	1.20		3.031	751
50	Hulu Ganga 2	1.60	2006											2.95	2.95		18.899	85
51	Gomala Oya	1.00	2006											0.80	0.80	3.058		
52	Gurugoda Oya	4.50	2006											4.50	4.50	5.091		
53	Coolbawan	0.75	2006											0.75	0.75	2.733		
54	Henfold	2.60	2006											2.60	2.60	7.180		
55	Dunsinane	2.70	2006											2.70	2.70	8.768		
56	Nilambe oya	0.75	2006											0.75	0.75	0.911		
57	Kolapathana	1.10	2006											1.10	1.10	2.126		
58	Guruluwana	2.00	2006											2.00	2.00	6.743		
59	Kuda Oya	1.00	2006											1.00	1.00	4.114		
60	Labuwewa	2.00	2006											2.00	2.00	5.203		
61	Forest Hill	0.30	2006											0.30	0.30	0.469		
63	Batatota	2.00	2007												2.00	8.204		
65	Kehelgamu oya	3.00	2007												3.00	8.193		
67	Kotankanda	0.15	2007												0.15	0.500		
68	Lower Neluwa	1.45	2007												1.45	0.002		

Source: Adapted from Sales and Generation Data Book , 2007, Ceylon Electricity Board and
Energy Data 2007, Sri Lanka Sustainable Energy Authority, and ranked by the year of Commercial Operation

Annex 4

Inputs to Investment Analysis

SENOK WIND POWER (PVT) LTD.- Investment Analysis

WTG model	**S64 TT 74 HH**
Tariff in Small Power Purchase Agreement	**Year 2008**

0 Location — **Mampuri**

1.0 Base Data

1.1	Project Cost (LKR million)	2,392
1.2	Construction Period (Months)	12
1.3	Guaranteed Plant Capacity (MW)	10
1.4	Debt (%)	46%
1.5	Equity (%)	54%
1.6	Term of Agreement (years)	20
1.7	Rs/US$ Exchange Rate	115

2.0 Project Cost

		LKR Million
2.1	Project development / implementation	52.53
2.2	Infrastructure development	58.62
2.3	Equipment price	1,522.10
2.4	Project supervision	8.21
2.5	Clearing & transport	89.69
2.6	Civil works	187.44
2.7	Erection	217.16
2.8	Transmission and Interconnection	120.75
2.9	Consultancy fees	20.00
2.10	Other Costs/contingencies	115.58
2.11	**Total Project Cost**	2,392.08

Financial Parameter	**Unit**	**Value**
Investment	LKR Million	2,392
Exchange Rate	LKR/USD	**115**
Percentage Debt	%	**46%**
AWDR	%	**11.72%**
AWFDR	%	**16.92%**
AWPLR	%	**19.31%**
Repayment Period	years	**7**
O&M Warranty	years	**2**
Escalation of Operation Cost	% per year	**6.0%**
Levelised Operational Cost	LKR./kWh	**3.46**
SPP Tariff (LKR/kWh)	O&M Tariff (yrs 1-20)	**2.14**
	Annual Escalation	**6.50%**
	Fixed Tariff (yrs 1-8)	**18.66**
	Fixed Tariff (yrs 9-15)	**7.03**
	Fixed Tariff (yrs 16-20)	**1.30**

Technical Parameter	**Unit**	**Value**
Turbine Capacity	kW	**1250**
No of Turbines	Nos.	**8**
Total Power Plant Capacity	MW	10
Average net plant factor	%	**31.55%**

Annex 5:

Monitoring Information

In calculating the operating margin emission factor, the ex-ante option was selected. Reference: **AMS-I.D Annex 12, Methodological tool (Version 01.1), "Tool to calculate the emission factor for an electricity system".** Accordingly, a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation was used, without requirement to monitor and recalculate the emissions factor during the crediting period. Therefore, only the net electricity exports from this small scale project activity to the connected electricity system shall be used in calculation of emission reductions.

The following formats for monitoring are shown in the subsequent pages.

Table A5.1- Format for Daily Monitoring of Power Plant Output (serves as the 2nd backup for main monitoring parameters)
Table A5.2- Format for Monthly Monitoring of Power Plant Output using the Backup Meter
Table A5.3- Format for Month Monitoring of Power Plant Output (primary data for CDM)
Table A5.4- Format for adjustments to Meter Readings and Calculation of Emission Reductions

Table A5.1- Format for Daily Monitoring of Power Plant Output

Information Monitoring Sheet for Cleaner Development Mechanism

Sheet #1
Purpose for CDM: 2nd Backup

Small Scale Project Activity	Mampuri Wind Power Plant	Date	01 October 2009
Location	Mampuri, Sri Lanka	Information entered by:	
Project Participant	Senok Wind Power (Pvt) Ltd.	Name(s)	1 / 2 / 3
Monitoring Frequency	Hourly for WTG output Mid-day for energy meter one sheet per day	Checked by Shift Supervisor:	Name Signature Date
		Reviewed and approved by Power Plant Manager	Name Signature Date

Information Mornitored:	Real Power Output of each Wind Turbine Generator (WTG)	**Units**	kW	**Measuring device**	Power meter at each WTG	**Source:**	SCADA

Hour (HH:MM)	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Wind turbine generator #																									
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									

Information Mornitored:	Cumulative Energy of each Wind Turbine Generator (WTG)	**Units**	kWh	**Measuring device**	Energy meter at each WTG	**Source:**	SCADA

Hour (HH:MM)	00:00	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Wind turbine generator #																									
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									

Mid-day Readings	**Measuring device**	Energy meter at each WTG	**Source**	Manual Reading at each WTG

Wind turbine generator #	Quantity	Reading at Time: 12:00	Units	State actual time of visit	Comments, observations on the meter (report any abnormalities)
1	Power		kW		
	Cum Energy		kWh		
2	Power		kW		
	Cum Energy		kWh		
3	Power		kW		
	Cum Energy		kWh		
4	Power		kW		
	Cum Energy		kWh		
5	Power		kW		
	Cum Energy		kWh		
6	Power		kW		
	Cum Energy		kWh		
7	Power		kW		
	Cum Energy		kWh		
8	Power		kW		
	Cum Energy		kWh		

Mid-day Readings	**Measuring device**	Back-up Meter at the Point of Supply	**Source**	Manual Reading at the Point of Supply

Back meter (at Point of Supply)		Reading at Time: 12:00	Units	State actual time of visit	Comments, observations on the meter (report any abnormalities)
Exports M1B	Cum Energy		kWh		
Imports M2B	Cum Energy		kWh		

Table A5.2- Format for Monthly Monitoring of Power Plant Output using the Backup Meter

Information Monitoring Sheet for Cleaner Development Mechanism

Sheet #2
Purpose for CDM: 1st Backup

Small Scale Project Activity	Mampuri Wind Power Plant	Year	2009
Location	Mampuri, Sri Lanka	Information entered by:	
Project Participant	Senok Wind Power (Pvt) Ltd.	Name(s)	1 / 2 / 3
Monitoring Frequency	Monthly		

Reviewed and approved by Power Plant Manager	Name	
	Signature	
	Date	

Information Mornitored:	Export and Import of energy to/from the national grid	**Units**	kWh
Measuring device	Backup meter (at Point of Supply)	**Source:**	Summarised from sheet #1

1st Day of Month at 12:00h	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Exports M1B												
Imports M2B												
State time if readings were not taken at 12:00h												

Back meter (at Point of Supply)	Summary of Comments, observations on the meter (report any abnormalities with date and time)
Exports M1B	
Imports M2B	

Table A5.3- Format for Month Monitoring of Power Plant Output (primary data for CDM)

Information Monitoring Sheet for Cleaner Development Mechanism

Sheet #3
Purpose for CDM: Primary source of information

Small Scale Project Activity	Mampuri Wind Power Plant	Year	2009		
Location	Mampuri, Sri Lanka	Information entered by:			
Project Participant	Senok Wind Power (Pvt) Ltd.	Name(s)	1	2	3
Monitoring Frequency	Monthly				

Reviewed and approved by Power Plant Manager	Name	
	Signature	
	Date	

Information Mornitored:	Export and Import of energy to/from the national grid	**Units**	kWh
Measuring devices	Main meter (at Point of Supply) [for readings M1 and M2]	**Source:**	
	Meter at the point of purchase from local distribution line [M3]	CEB Meter readings	

On the date of CEB meter reading	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Date of reading												
Exports M1												
Imports M2												
State the time of meter reading												
Attach photograph of meter clearly displaying the readings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source:	
CEB monthly invoice	

Date of reading												
Imports M3												

Meter	Summary of Comments, observations on the meter (report any abnormalities with date and time)
Exports M1	
Imports M2	
Imports M3	

Table A5.4- Format for adjustments to Meter Readings and Calculation of Emission Reductions

Information Monitoring Sheet for Cleaner Development Mechanism

Sheet #4
Purpose for CDM: Submission for Verification

Small Scale Project Activity	Mampuri Wind Power Plant	Year	2009
Location	Mampuri, Sri Lanka	Information entered by:	
Project Participant	Senok Wind Power (Pvt) Ltd.	Name(s)	1 / 2 / 3
Monitoring Frequency	Monthly		

Reviewed and approved by Power Plant Manager	Name	
	Signature	
	Date	

Approved by President Senok Wind Power (Pvt) Ltd.	Name	
	Signature	
	Date	

Information Provided:	Calculation of Emission Reductions for one year

Measuring devices	Main meter (at Point of Supply) [for readings M1 and M2]
	Meter at the point of purchase from local distribution line [M3]

Source:
CEB Meter readings

Record of readings (see below for notes on any corrections already included) **Units:** kWh

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Exports M1														
Imports M2														
Imports M3														

Meter	Summary of Comments, observations on the meter (report any abnormalities with date and time, and corrrections done)
Exports M1	
Imports M2	
Imports M3	

Calculated energy reading **Units:** kWh

	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Exports M1													
Imports M2													
Imports M3													

Note: Calculated reading = Reading this month - reading in the previous month

If the December reading date is not 31 Dec or 1 Jan
Adjusted energy reading for January = 31 x (calculated energy reading for Dec previous year+ calculated energy reading for Jan)/62
Adjusted energy reading for December = 31 x (calculated energy reading for Dec + calculated energy reading for Jan next year)/62

Calculated energy reading with adjustments for Jan and Dec **Units:** kWh

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total for year
Exports M1													
Imports M2													
Imports M3													
Net export M1-(M2+M3)													

Year: 2010

Approved combined margin emission factor		kg-CO2/kWh
Total net export to the connected electricity system		kWh
Emission reductions submitetd for verification		t-CO2