COMPONENT PROJECT ACTIVITY DESIGN DOCUMENT FORM (F-CDM-CPA-DD)
Version 02.0

COMPONENT PROJECT ACTIVITIES DESIGN DOCUMENT (CPA-DD)

SECTION A. General description of CPA

A.1. Title of the proposed or registered PoA

Energy and Water Saving Promotion Programme for Textile Dyeing Process of Bangladesh Textile and Garment Industries

A.2. Title of the CPA

Energy and Water Saving Promotion for Textile Dyeing Process of Grameen Knitwear Textile and Garment Factory in Bangladesh

Version: 2.0
Date: 28/11/2012

A.3. Description of the CPA

The CPA targets Textile and Garment factory of Grameen Knitwear Limited (GK), established in 1997, is a 100% export oriented factory located in the Export Processing Zone (DEPZ) in Savar Dhaka. GK has a dyeing capacity of 8 ton/day. As it is located in DEPZ area, the factory has to pay bill for each cubic water they are using not only for fresh water but also for effluent water they are discharging to the central ETP (effluent treatment plant) of DEPZ after treating the waster water in their own ETP. GK also has to buy electricity from United Power Generation and Distribution Company, Ltd. that provides power to the DEPZ.

The CPA aims to save water and energy in the factory through optimizing textile dyeing process in dyeing machines through introducing high quality cotton yarn, changing dyeing process from current reactive dyes to directive dyes and other appropriate dyeing ways according to requirements of buyers. The GK, with the help of W.S.T takes a lead by introducing water and energy saving technology to its own factory through the CPA under the PoA by introducing directive dyes for cottons with proposing high quality yarn, one bath dyes for CVCs and cationic dyes for polyesters.

The baseline scenario is the continuation of current dyeing practices in the factory that are reactive dyes for cotton and disperse dyes for CVC and polyester that is the most dominant dyeing practice in Bangladesh textile and garment industry.

The CPA will contribute to sustainable development in the host country through the following social and environmental benefits:

- The project will contribute to ensure future water security in Bangladesh through reducing underground water consumption for textile dyeing process significantly.
- The project will contribute to ease land subsidence having occurred in Dhaka area, as the reducing consumption of underground water is an indispensable way for preventing the disfigurement of land and its calamitous effects.

A.4. Entity/individual responsible for CPA

The Grameen Knitwear Ltd. (GK) is the implementer of the CPA.

A.5. Technical description of the CPA

As mentioned before, the CPA targets Textile and Garment factory of the GK and promotes process optimization from yarn to fabric for textile dyeing. The CPA mainly focuses on the dyeing machines at the factory.

The layout of dyeing and finishing section of the factory is given in the figure 1 below. As shown in the layout of the factory, the factory has 5 dyeing machines they are Sclavos jet dyeing machines on which dyes with a bath ratio of 1:8 and overflow rinsing (no stop process for drain and fill with four nozzles and 180 litre water/min per nozzle) have been conducted. The table 1 below shows the information about the dyeing machines.

Table 1. Dyeing Machines in the Factory

				
Athena-H	**VAT-4**	**VHT-3**	**VHT-1**	**VHT-4**
1000kg	720 kg	540kg	180kg	720kg
2006	1998	1998	1998	2003
CVC/PET/C100	CVC/PET/C100	Cotton only	CVC/PET/C100	CVC/PET/C100

The steams need for the dyeing and finishing process being provided by 4 boilers at the factory. Among the 4 boilers, 2 of them (boiler 1 and 2 in the figure above) exclusively have provided steams for dyeing and finishing section. The following table 2 shows information about the boilers in the factory.

Table 2. Boilers Information in the Factory

Item	Unit	Boiler 01	Boiler 02	Boiler 03	Boiler 04
Manufacture year:	-	1998	1998	2003	2006
Brand name	-	COCHRAN	COCHRAN	COCHRAN	COCHRAN
Origin	-	UK	UK	UK	UK
Types	-	Fire tube	Fire tube	Fire tube: Diesel fuel	Fire tube: Diesel fuel
Steam Generating Capacity	Kg/hr	3,630	4,535	1,500	5,000
Design pressure	bar	12	12	12	12
Working Pressure	bar	10	10	10	10
Fuel (Gas) Consumption	M3/hr (L /hr)	259	324	11	(353)
	M3/Day (L./month)	6,206	7,781	1,114	(3,528)
Remarks				Operation time (10hr/day) (For garment ironing)	For back up (Maximum operation time is 10hr/month)

The lifetime of Sclavos dyeing machines are said to be 25 years. As the oldest machines in the factory are 14 years old, the average life expectancy of dyeing machines in the factory is 15 years.

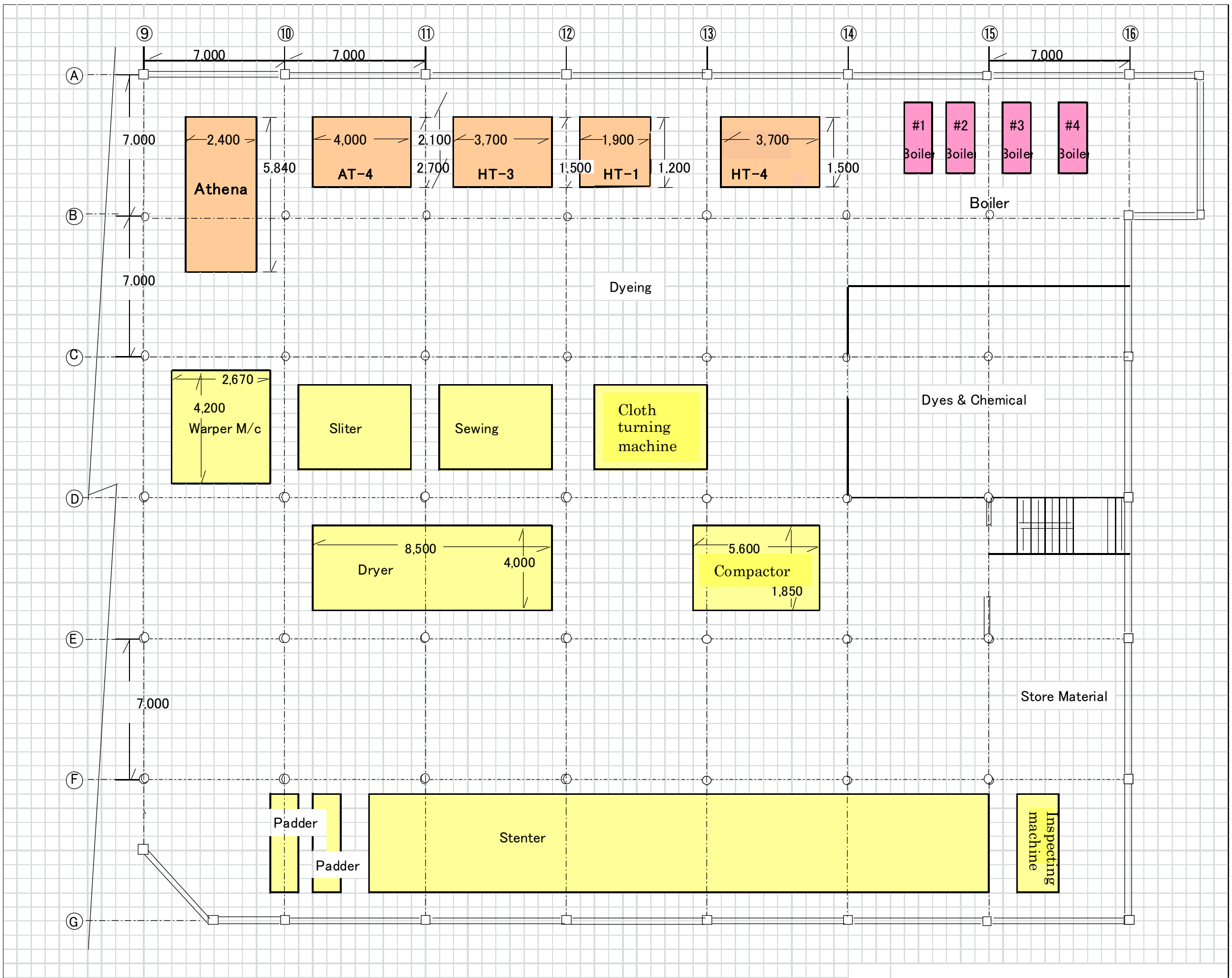

Fig:G1 GKL Dyeing & Finishing Dep. M/C Arranged

Figure 1. The Layout of the Factory

The CPA does not intend to change or replace any facilities having been used in the factory. The facilities and systems like dyeing machines, boilers, water softening and effluent treatment systems are identical in the both baseline and project scenario. The energy and mass flows of the CPA and related facilities that are identical for both baseline and project scenario are shown in the figure 2 below.

The baseline scenario of the CPA is a continuation of the current dyeing practices such as reactive dyes with enzyme for cotton, reactive+ disperse for CVCs and disperse dyes for polyesters.

The CPA intrudes to use Combed Cotton Yarn with Low Twist instead of inferior cotton yarn used in most factories to avoid enzyme wash practiced in the factory. At the same time, the CPA introduce direct dyes, new generation Reactive dyes, Vat dyes and Sulfur +Reactive Dyes for cotton according to buyers requirement for shades. On the other hand, for the CVC, one batch or scour dyes and for polyester the cationic dyes are introduced instead of current disperse dyes.

The measures introduced by the CPA reduce dyes and chemicals need for a batch so that reduce water consumption for a match. The reduction of water consumption for the batch results in significant reduction of dyeing time for the batch. Obviously, reduction of electricity and steam consumption for the batch can be obtained through reduction of the dyeing time of the batch.

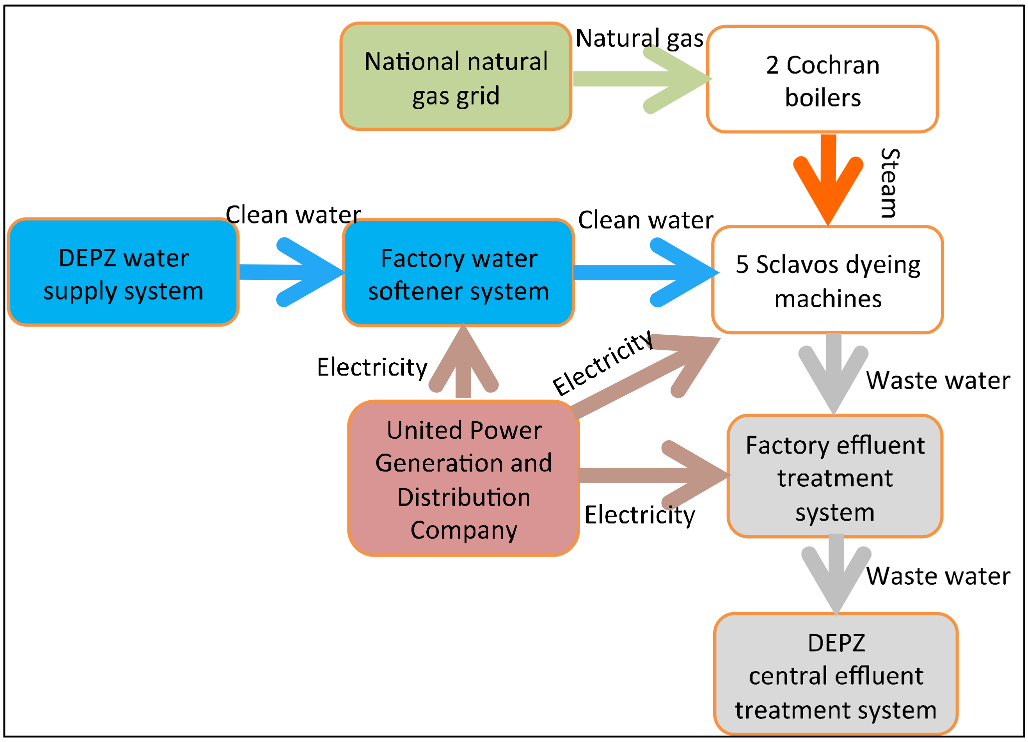

Figure 2. Energy and Mass Flows in the CPA

Thus, GHG (mainly CO_2) emission reduction from the CPA is realized from reduction of electricity consumption and steam consumption of dyeing machine for a batch. Meanwhile a reduction of electricity consumption for pumping groundwater and pumping waster water from tank to tank at the ETP can also be reached.

Clean water for the factory is from a water supply system of the DEPZ, which extracts groundwater with pumps. And waste water from the dyeing process goes to the factory's own ETP before discharged to central ETP of the DEPZ.

However, the pumping of wastewater from tank to tank in the factory is seen to consume not much electricity as the total dynamic heads between tanks at the factory's ETP are significant as shown in the figure 3 above. Therefore, the impact of the CPA on this part will be neglected.

So far, the factory has not installed meters such as electric meters and steam flow meters for machines for energy management; the CPA will install electric meters and steam flow meters to each machine for monitoring electricity and steam consumption of dyeing machines for each batch.

For monitoring electricity consumption of dyeing machines, kWh meters will be installed at the easy visible points of power lines to the machines. For monitoring steam consumption of dyeing machines, clamp-on ultrasonic flow meters are under consideration for installing at the appropriate points of steam pipes to the machines. The clamp-on ultrasonic flow meters are non-intrusive and no interruption in factory operation during installation and calibration.

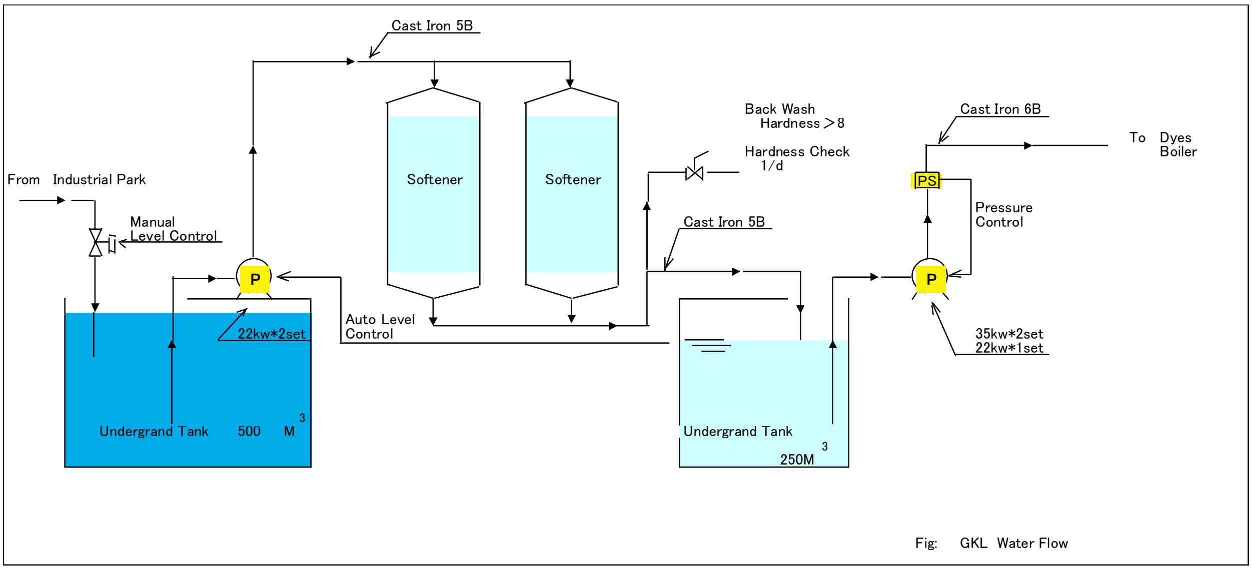

Figure 3. Water Softer System of the Factory

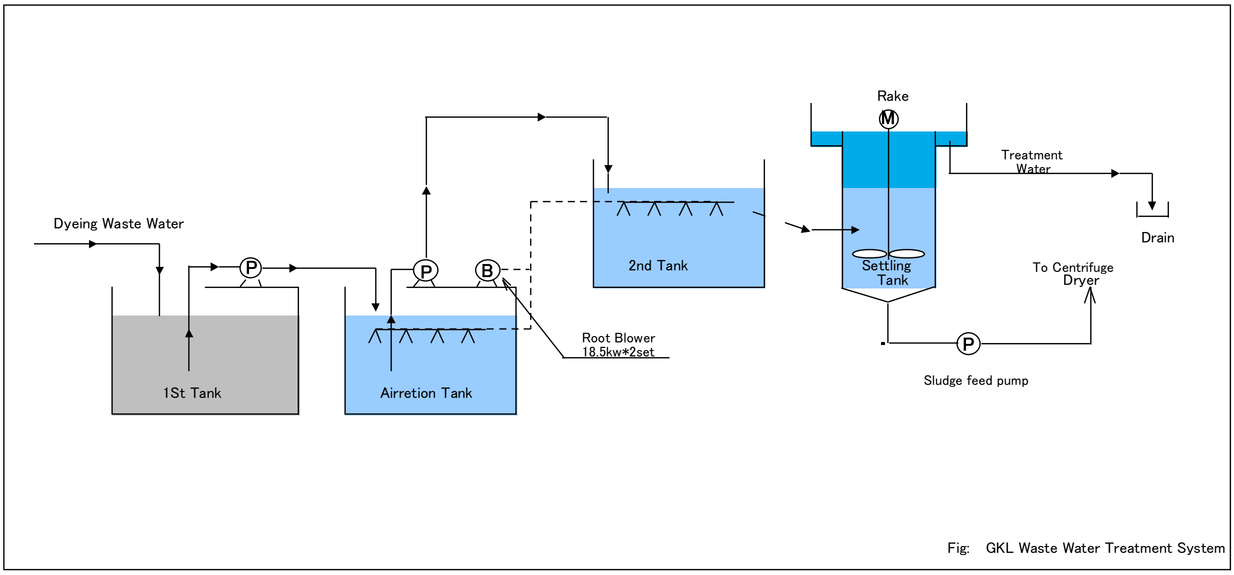

Figure 4. Effluent Treatment Plant of the Factory

For the factory, in the case of 100% cotton in dark, it is estimated that the CPA (good quality yarn and directive dyes) may cut water and steam consumption by 50% and electricity consumption by 75% through reducing dyeing time from 8 hours to 3 hours for a batch.

A.6. Party (ies)

Name of Party involved (host) indicates a host Party	Private and/or public entity (ies) CPA implementer(s) (as applicable)	Indicate if the Party involved wishes to be considered as CPA implementer (Yes/No)
Bangladesh (host)	Grameen Knitwear, Ltd. Green Project W.S.T	No
Japan	PEAR Carbon Offset Initiative, Ltd.	No

A.7. Geographic reference or other means of identification

The Textile and Garment factory of the Grameen Knitwear Ltd. is located in DEPZ (23°56'44"N 90°16'47"E) that is 35 km from Dhaka city centre and 25 km from International Airport. The factory's address is PLOT-102, 103, 126 and 127, DEPZ, Ganakbari, Savar, Dhaka.

Figure 5. Geographic Reference of the Factory

A.8. Duration of the CPA
A.8.1. Start date of the CPA

The start date of the CPA is 2/12/2012 on which the water and energy saving technologies duly start to be implemented in the factory.

A.8.2. Expected operational lifetime of the CPA

15 years 0 month

A.9. Choice of the crediting period and related information

Fixed crediting period is chosen.

A.9.1. Start date of the crediting period

01/06/2013 or the date of registration of the PoA, whichever is later

A.9.2. Length of the crediting period

The duration of crediting period of the CPA is 10 years 0 month and it is limited to the end date of the PoA regardless of when the CPA was added.

A.10. Estimated amount of GHG emission reductions

Emission reductions during the crediting period	
Years	**Annual GHG emission reductions (in tonnes of CO_2e) for each year**
01/06/2013	6,368
01/06/2014	6,368
01/06/2015	6,368
01/06/2016	6,368
01/06/2017	6,368
01/06/2018	6,368
01/06/2019	6,368
01/06/2020	6,368
01/06/2021	6,368
01/06/2022	6,836
Total number of crediting years	10 years
Annual average GHG emission reductions over the crediting period	6,836
Total estimated reductions (tonnes of CO_2e)	68,360

A.11. Public funding of the CPA

No public fund is used for the CPA

A.12. Debundling of small-scale component project activities

According to "GUIDANCE FOR DETERMINING THE OCCURRENCE OF DEBUNDLING UNDER A PROGRAMME OF ACTIVITIES (PoA), version 03.0", a proposed small-scale CPA of a PoA shall be deemed to be a de-bundled component of a large scale activity if there is already an activity, [1]which satisfies both conditions (a) and (b) below:

(a) Has the same activity implementer as the proposed small scale CPA or has a coordinating or managing entity, which also manages a large scale PoA of the same technology/measure, and;

(b) The boundary is within 1 km of the boundary of the proposed small-scale CPA, at the closest point.

So far, in Bangladesh, there has been no any registered small-scale CPA of a PoA or proposed small-scale CPA of a PoA or a registered small-scale CDM project is implemented by the Grameen Knitwear or coordinated by W.S.T and also there has been no any registered small-scale CPA of a PoA or proposed

[1] Which may be a (i) registered small-scale CPA of a PoA, (ii) an application to register another small-scale CPA of a PoA or (iii) another registered CDM project activity.

small-scale CPA of a PoA or a registered small-scale CDM project within 1 km of the boundary of the CPA. Therefore, the CPA is not a de-bundled component of a large scale activity.

A.13. Confirmation for CPA

There have been no CDM project activities or PoAs relating to textile and garment industry in Bangladesh and further more, there have been no any other CDM project activities or PoAs proposed or implemented by the CME in Bangladesh. Thus it follows that the proposed CPA is neither registered as an individual CDM project activity or is part of another registered PoA.

SECTION B. Environmental analysis

B.1. Analysis of the environmental impacts

The environmental impacts have been analyzed at the PoA level.

SECTION C. Local stakeholder comments

C.1. Solicitation of comments from local stakeholders

A PoA level Local Stakeholder Consultation Meeting was held at Uttara Club (Lotus Hall), Dhaka on 5th of November 2012.

C.2. Summary of comments received

The local stakeholder consultation is provided at the PoA level. Please refer to F.2 of the PoA-DD.

C.3. Report on consideration of comments received

The local stakeholder consultation is provided at the PoA level. Please refer to F.3 of the PoA-DD.

SECTION D. Eligibility of CPA and estimation of emissions reductions

D.1. Title and reference of the approved baseline and monitoring methodology (ies) selected:

The methodology of AMS-II.D (Energy efficiency and fuel switching measures for industrial facilities, version 12) is applied for the CPA.

D.2. Application of methodology (ies)

The justification of applicability of the methodology is given in the table below.

No	Applicable conditions of the Methodology	Conformity of the CPA
1	This category comprises any energy efficiency and fuel switching measures implemented at a single or several industrial or mining and mineral production facility/ies. This category covers project activities aimed primarily at energy efficiency;	The CPA targets Textile and Garment factory to improve energy efficiency on textile dyeing process through introducing water and energy saving technologies
2	This category is applicable to project activities where it is possible to directly measure and record the energy use within the project boundary (e.g., electricity and/or fossil fuel consumption).	The electricity and fossil fuel consumption for textile dyeing process can be measured or calculated through directly measured value by meters installed at corresponding points of energy an water supply lines.
3	This category is applicable to project activities where the impact of the measures implemented (improvements in energy efficiency) by the project activity can be clearly distinguished from changes in energy use due to other variables not influenced by the project activity (signal to noise ratio).	The CPA focuses on dyeing machines. Then the target of the measures is clear; the impacts of the measures are distinguishable.
4	The aggregate energy savings of a single project (inclusive of a single facility or several facilities) may not exceed the equivalent of 60 GWh_e per year. A total saving of 60 GWh_e per year is equivalent to a maximal saving of 180 GWh_{th} per year in fuel input.	For every year during the crediting period, the aggregate energy savings of the CPA under the PoA will not exceed 180 GWh_{th} per year. The aggregate energy savings of the CPA is estimated to be up to 15GWh_{th}/year for the first crediting period.

As the CPA can satisfy all applicability and other conditions of the AMS-II.D, then the methodology can be applied for the CPA.

D.3. Sources and GHGs

The proposed CPA is located in the geographical boundary of the PoA as it targets the factory of GK that located in DEPZ of Bangladesh and the boundary of the CPA specifically covers the following facilities and systems in the factory.

- The dyeing machines
- The effluent treatment plant of the factory
- The boilers

Besides that the spatial extent of the boundary of the CPA includes the water supply system of the DEPZ from where the factory is gaining clean water and United Power Generation & Distribution Company, which is also located in the DEPZ and provide electricity for the factory.

The figure 5 below depicts the points of emission sources and monitoring and delineates the geographical boundary of the CPA.

However, electricity consumption for pumping waster water from one tank to another tank at the ETP of the factory is seen to be negligible as the heads between the tanks are not significant.

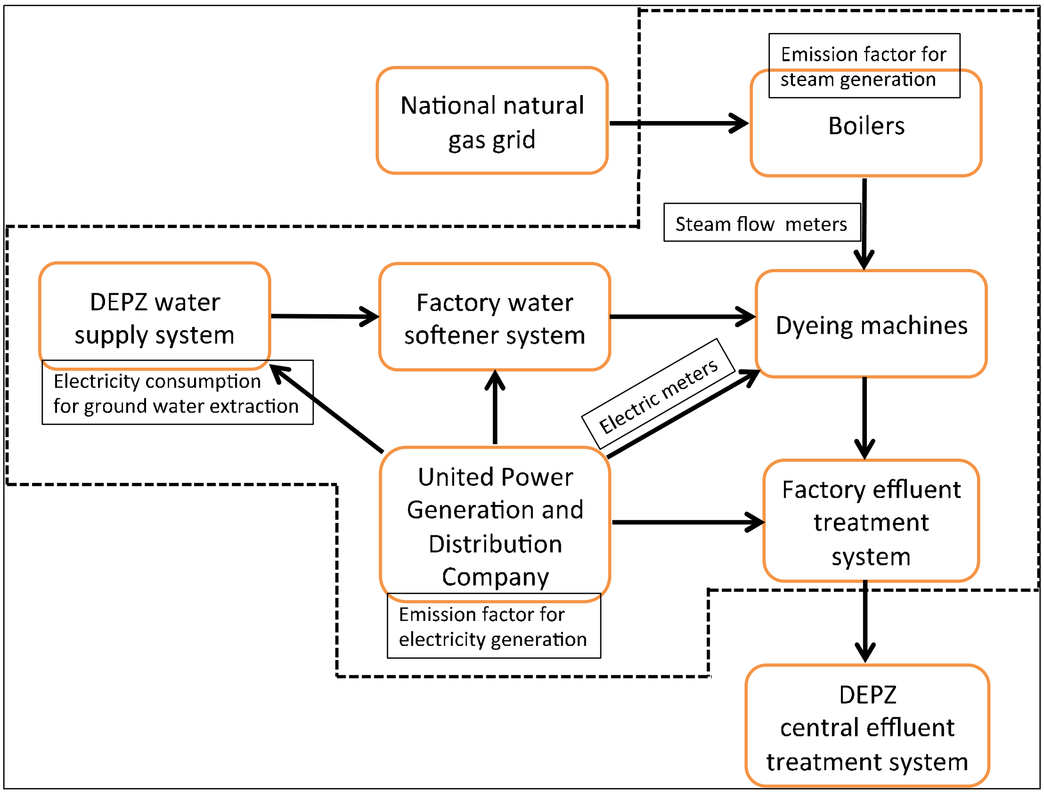

Figure 6. Physical Delineation of the CPA

Source		GHGs	Included?	Justification/Explanation
Baseline	Electricity consumption of dyeing machines for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Steam consumption of dyeing machines for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Electricity consumption for pumping up water that used in dyeing processes for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
Project	Electricity consumption of dyeing machines for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Steam consumption of dyeing machines for textile dyeing	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected
		N_2O	No	Minor Source and thereby neglected
	Electricity consumption for pumping up water that used	CO_2	Yes	Major Source of emissions
		CH_4	No	Minor Source and thereby neglected

	in dyeing processes for textile dyeing	N_2O	No	Minor Source and thereby neglected

As per the methodology AMS-II.D, the source and GHGs considered in the CPA is given in the table below.

D.4. Description of the baseline scenario

As per the methodology AMS II.D./version 12, the baseline scenario for the CPA is demonstrated as follows.

In the absence of the CDM project activity, the Grameen Knitwear would continue to apply the current conventional dyeing practices to consume energy at historical average levels, until the time at which the dyeing practices would be likely to be replaced by the energy and water saving technologies in the absence of the CDM project activity.

The current dyeing practices in the factory are reactive dyes for cellulose (mainly cottons), disperse dyes for CVC and Polyesters regardless of fabric colors. The water and energy consumption for the current dyeing practices in the case of Sclavos machines with 1000 kg capacity is given as follows.

Machine: Sclavos
Unit: kWh/batch
Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	**Light**	**Medium**	**Dark**
Cellulose	238	238	257
CVC	273	280	316
Polyester	89	99	119

Machine: Sclavos
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	**Light**	**Medium**	**Dark**
Cellulose	87,200	94,400	105,200
CVC	105,600	105,600	123,600
Polyester	40,400	40,400	51,200

Machine: Sclavos
Unit: kg-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	5,797	6,348	6,969
CVC	6,570	65,70	7,672
Polyester	2,902	2,930	3,592

The fabric load of dyeing machines are various and generally in most factory the fabric load ranges 80%~95%. Then, water and energy consumption respectively for 80%, 85%, 90% and 95% fabric loads are used for baseline water and energy consumption. For conservativeness, as per monitoring data, the value of 80% is used for the case of 80%~85%, the value of 85% for the case of 85%~90%, the value of 90% for the case of 90%~95%, the value of 95% for the case of higher than 95%.

D.5. Demonstration of eligibility for a CPA

No	Eligibility Criteria	Conformity Yes or No
1	The CPA targets a textile and garment factory in Bangladesh	Yes
2	The name and the address of the factory are defined	Yes
3	The CPA is a new project which is not registered large scale CDM or SSC-CPA in the other PoA	Yes, please refer to A.12 in above
4	There is unique identification of the target factory	Yes
5	Is it possible to submit specification of technology/measure when the DOE validates or verify?	Yes
5	The start date of a CPA is not, or will not be, prior to the commencement of validation of the PoA.	Yes, the starting date of the CPA is after the commencement of the validation of the PoA, 20 November 2012.
7	Does the CPA meet the applicability and other requirements of AMS-II.D as described in PoA-DD	Yes, please refer to D.2 in the above
8	The achieved energy saving of the CPA at a scale of no more than 60 GWh_{th} per year	Yes, for every year during the crediting period, the aggregate energy savings of the CPA will not exceed 60 GWh_{th} per year. The achieved total energy saving from the CPA is estimated to be up to 15 GWh_{th} per year among which 3 GWh_{th} is from electricity saving and other 12 GWh_{th} is from steam saving.
9	If the above condition is not satisfied, a barrier due to prevailing practice in Bangladesh Textile and Garment industry said reactive dyes for cellulose; disperse dyes for CVC and polyester would prevent occurrence of CPAs.	N/A
10	A CPA performs local stakeholder consultation before the inclusion of SSC-CPA.	Yes, the local stakeholder consultation at PoA level was held on 5 November 2012
11	A CPA does not need to performs the environmental impacts analysis according to the regulation of Bangladesh	Yes
12	The CPA does not use any fund from Annex I parties	Yes
13	If the CPA uses a fund from Annex I parties then it does not result in a diversion of official development assistance	N/A

14	The CPA-DD applies 95/10 (confidence /precision) for any necessary survey according	Yes
15	The aggregate energy savings by a CPA does not exceed the equivalent of 180 GWh_{th} per year	Yes,
16	Is a CPA confirmed to a single project, which is not a de-bundled component of another large-scale CPA or CDM project activity as per the latest guidance given in CDM EB?	Yes
17	Is the crediting period of the CPA is within the crediting period of the PoA?	Yes, as the CPA has 10 years crediting period and it is the first CPA of the PoA, so it is hardly said that the crediting period of the CPA exceeds the crediting period of the PoA

As the CPA satisfied all eligibility criteria given in the PoA-DD, then the CPA is eligible for the PoA.

D.6. Estimation of emission reductions
D.6.1. Explanation of methodological choices

Baseline Emissions

As mentioned before, the baseline scenario for the project is the continuation of current dyeing process (mainly conventional reactive dyeing) in the factory.

According to the methodology ASM-II-D, the baseline emission can be calculated based on the following equation.

$$BE_y = (EC^{BL}_{Dyeing,y} + EC^{BL}_{Water,y}) \times EF^{BL,elec}_{CO2} + SC^{BL}_y \times EF^{BL,steam}_{CO2} \quad (1)$$

Where:

BE_y	Baseline emissions in a year y (CO_2 ton/year)
$EC^{BL}_{Dyeing,y}$	Baseline electricity consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year y (kWh/year)
$EC^{BL}_{Water,y}$	Baseline electricity consumption by pumping of fresh water that used in dyeing machines in year y (kWh/year)
SC^{BL}_y	Baseline steam consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year y (ton-steam/year)
$EF^{BL,elec}_{CO2}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
$EF^{BL,steam}_{CO2}$	CO_2 emission factor for the steam generation for the factory (ton CO_2/ton)

$$EC^{BL}_{Dyeing,y} = \sum_i \sum_j \sum_k \sum_l EC^{BL,Batch,dyeing}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \quad (2)$$

Where:

$EC^{BL}_{Dyeing,y}$	Baseline electricity consumption by dyeing processes in year y (kWh/year)
$EC^{BL,Batch,dyeing}_{i,j,k,l}$	Historical average electricity consumption of a dyeing machine i for a batch in the baseline dyeing process for brightness of colour j material k at a load-type of l (kWh/batch)
$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a dyeing machine i in the project dyeing for brightness of color j material k at a load-type of l in a year y
i	Types of dyeing machines in the factory (different maker and different capacity)
j	Brightness of color of textile being dyed in the factory (j: light, medium, dark)
k	Type of textile being dyeing in the factory (k: cellulose, CVC and polyester)
l	Type of load for dyeing machine in the factory

$$EC^{BL}_{Water,y} = \sum_i \sum_j \sum_k \sum_l WC^{BL,Batch}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \times EC^{BL,pumping}_{clean,water} \quad (3)$$

Where:

$EF^{BL}_{Water,y}$	Baseline electricity consumption by pumping of water that used in dyeing machines in year y (kWh/year)
$WC^{BL,Batch}_{i,j,k,l}$	Historical average water consumption in machine i for a batch in the baseline dyeing process for colour j material k at a load of l (Litre/batch)
$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a machine i in the project dyeing for color j material k at a load of l in a year y
$EC^{BL,pumping}_{clean,water}$	Historical average electricity consumption for pumping groundwater (kWh/liter)
i	Type of dyeing machines in the factory
j	Color of textile being dyed in the factory (j: light, medium, dark)
k	Type of textile being dyeing in the factory (k: cellulose, CVC and polyester)
l	Different load for dyeing a machine in the factory

$$SC^{BL}_{y} = \sum_i \sum_j \sum_k \sum_l SC^{BL,Batch}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \quad (4)$$

Where:

SC^{BL}_{y}	Baseline steam consumption by dyeing processes in year y (ton/year)
$SC^{BL,Batch}_{i,j,k,l}$	Historical average steam consumption of a dyeing machine i for a batch in the baseline dyeing process for colour j material k at a load-type of l (ton-steam/batch)
$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a machine i in the project dyeing for color j material k at a load-type of l in a year y

i	Type of dyeing machines in the factory
j	Brightness of color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Type of load for dyeing machine in the factory

$$EF_{CO2}^{BL,elec} = \frac{FC_{gen}^{BL,fuel} \times De_{gen}^{fuel} \times NCV_{gen}^{fuel} \times EF_{CO2}^{fuel,gen}}{EG_{gen}^{BL,fuel}} \quad (5)$$

Where:

$EF_{CO2}^{BL,elec}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
$EG_{gen}^{BL,fuel}$	Historical average of electricity generated from generators (kWh/year). Data for the past three years is preferable; at least one-year vintage data is necessary.
$FC_{gen}^{BL.fuel}$	Historical fuel consumption average of generators (m^3/year). Data for the past three years is preferable; at least one-year vintage data is necessary.
NCV_{gen}^{fuel}	Net caloric value of the fuel used for generators (TJ/Gg)
De_{gen}^{fuel}	Density of the fuel for generators (kg/m^3)
$EF_{CO2}^{fuel,gen}$	CO_2 emission factor of the fuel for generators (kg-ton CO_2/TJ)

$$EF_{CO2}^{BL,steam} = \frac{FC_{boiler}^{BL,fuel} \times De_{boiler}^{fuel} \times NCV_{boiler}^{fuel} \times EF_{CO2}^{fuel,boiler}}{SP_{boiler}^{BL,fuel}} \quad (6)$$

Where:

$EF_{CO2}^{BL,steam}$	CO_2 emission factor for the steam generation (ton CO_2/ton steam)
$SP_{steam}^{BL,fuel}$	Historical amount of steam produced from boilers (ton-steam/year). Data for the past three years is preferable; at least one-year vintage data is necessary.
$FC_{steam}^{BL,fuel}$	Historical fuel consumption of boilers (m^3/year). Data for the past three years is preferable; at least one-year vintage data is necessary.
NCV_{steam}^{fuel}	Net caloric value of the fuel used for boilers (TJ/Gg)
De_{steam}^{fuel}	Density of the fuel for boilers (kg/m^3)
$EF_{CO2}^{fuel,boiler}$	CO_2 emission factor of the fuel for boilers (kg-ton CO_2/TJ)

<u>Project Emissions</u>

$$PE_y = (EC_{Dyeing,y}^{PJ} + EC_{Water,y}^{PJ}) \times EF_{CO2}^{PJ,elec} + SC_y^{PJ} \times EF_{CO2}^{PJ,steam} \quad (7)$$

Where:

PE_y	Project emission in a year y (CO_2 ton/year)
$EC^{PJ}_{Dyeing,y}$	Project electricity consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (kWh/year)
$EC^{PJ}_{Water,y}$	Project electricity consumption by pumping of water that used in dyeing machines in the factory in year y (kWh/year)
SC^{PJ}_{y}	Project steam consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (ton-steam /year)
$EF^{PJ,elec}_{CO2}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
EF^{steam}_{CO2}	CO_2 emission factor for the steam generation for the factory (ton CO_2/ton)

$$EC^{PJ}_{Dyeing,y} = \sum_i \sum_j \sum_k \sum_l EC^{PJ,Batch,dyeing}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \quad (8)$$

Where:

$EC^{PJ}_{Dyeing,y}$	Project electricity consumption by dyeing processes in year *y* (kWh/year)
$EC^{PJ,Batch,dyeing}_{i,j,k,l}$	Electricity consumption of a machine *i* for a batch in the project dyeing process for brightness of colour *j* material *k* at a load-type of *l* (kWh/batch)
$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a machine *i* in the project dyeing for brightness of color *j* material *k* at a load-type of *l* in a year y
i	Type of dyeing machines in the factory
j	Brightness of color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Type of load for dyeing machine in the factory

$$EF^{PJ}_{Water,y} = \sum_i \sum_j \sum_k \sum_l WC^{PJ,Batch}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \times EC^{PJ,pumping}_{fresh,water} \quad (9)$$

Where:

$EF^{PJ}_{Water,y}$	Project electricity consumption by pumping of water that used in dyeing machines in year y (kWh/year)
$WC^{PJ,Batch}_{i,j,k,l}$	Water consumption in machine *i* for a batch in the baseline dyeing process for colour *j* material *k* at a load of *l* (Litre/batch)
$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a machine *i* in the project dyeing for color *j* material *k* at a load of *l* in a year y
$EC^{PJ,pumping}_{fresh,water}$	Average electricity consumption for pumping underground water in the project in year y (kWh/liter)
i	Type of dyeing machines in the factory
j	Color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Different load for dyeing a machine in the factory

$$SC_y^{PJ} = \sum_i \sum_j \sum_k \sum_l SC_{i,j,k,l}^{PJ,Batch} \times NB_{i,j,k,l,y}^{PJ} \qquad (10)$$

Where:

SC_y^{BL}	Project steam consumption by dyeing processes in year *y* (ton-steam /year)
$SC_{i,j,k,l}^{BL,Batch}$	Steam consumption of a machine *i* for a batch in the baseline dyeing process for brightness of colour *j,* material *k* at a load-type of *l* (ton-steam /batch)
$NB_{i,j,k,l,y}^{PJ}$	Number of batches on a machine *i* in the project dyeing for brightness of color *j* material *k* at a load-type of *l* in a year *y*
i	Type of dyeing machines in the factory
j	Brightness of color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Type of load for dyeing a machine in the factory

$$EF_{CO2}^{PJ,elec} = \frac{FC_{gen}^{PJ,fuel} \times De_{gen}^{fuel} \times NCV_{gen}^{fuel} \times EF_{CO2}^{fuel,gen}}{EG_{gen}^{PJ,fuel}} \qquad (11)$$

Where:

$EF_{CO2}^{PJ,elec}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
$EG_{gen}^{PJ,fuel}$	Amount of electricity generated from generators (kWh/year) in year y.
$FC_{gen}^{PJ.fuel}$	Amount fuel consumption of generators (m^3/year) in a year y.
NCV_{gen}^{fuel}	Net caloric value of the fuel used for generators (TJ/Gg)
De_{gen}^{fuel}	Density of the fuel for generators (kg/m^3)
$EF_{CO2}^{fuel,gen}$	CO_2 emission factor of the fuel for generators (kg-ton CO_2/TJ)

$$EF_{CO2}^{PJ,steam} = \frac{FC_{boiler}^{PJ,fuel} \times De_{boiler}^{fuel} \times NCV_{boiler}^{fuel} \times EF_{CO2}^{fuel,boiler}}{SP_{boiler}^{PJ,fuel}} \qquad (12)$$

Where:

$EF_{CO2}^{PJ,steam}$	CO_2 emission factor for the steam generation for the factory (ton CO_2/ton steam)
$SP_{steam}^{PJ,fuel}$	Amount of steam produced from boilers (ton-steam/year) in a year y.
$FC_{steam}^{PJ,fuel}$	Amount of fuel consumption of boilers (m^3/year) in a year y.
NCV_{steam}^{fuel}	Net caloric value of the fuel used for boilers (TJ/Gg)
De_{steam}^{fuel}	Density of the fuel for boilers (kg/m^3)

$EF_{CO2}^{fuel,boiler}$	CO_2 emission factor of the fuel for boilers (kg-ton CO_2/TJ)

Leakage

There are no leakage emissions identified for this type of project.
Therefore:

$$L = 0 \quad (13)$$

Emission Reduction

$$ER_y = BE_y - PE_y \quad (14)$$

Where:

ER_y	Emission reduction in year y (ton/year)
BE_y	Baseline emission in a year y (CO_2 ton/year)
PE_y	Project emission in a year y (CO_2 ton/year)

D.6.2. Data and parameters that are to be reported ex-ante

Data / Parameter	$EC_{i,j,k,l}^{BL,Batch,dyeing}$
Unit	kWh/batch
Description	Historical average electricity consumption of a machine *i* for a batch in the baseline dyeing process for colour *j* material *k* at a load of *l* at the factory
Source of data	Project implementer
Value(s) applied	Please refer to Appendix 4
Choice of data or Measurement methods and procedures	Measured and calculated through baseline measurement campaign
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	$WC_{i,j,k,l}^{BL,Batch}$
Unit	Litre/batch
Description	Historical average water consumption of a machine i for a batch in the baseline dyeing process for colour j material k at a load of l at the factory
Source of data	Project implementer
Value(s) applied	Please refer to Appendix 4
Choice of data or Measurement methods and procedures	Measured and calculated through baseline measurement campaign
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	$EC_{fresh,water}^{BL,pumping}$
Unit	kWh/liter
Description	Historical average electricity consumption for pumping underground water
Source of data	Project implementer
Value(s) applied	0.2
Choice of data or Measurement methods and procedures	Measured and calculated through baseline measurement campaign
Purpose of data	Used to calculate the baseline emissions
Additional comment	Data assumed

Data / Parameter	$SC_{i,j,k,l}^{BL,Batch}$
Unit	Ton-steam/batch
Description	Historical average steam consumption of a machine i for a batch in the baseline dyeing process for colour j material k at a load of l
Source of data	Project implementer
Value(s) applied	Please refer to Appendix 4
Choice of data or Measurement methods and procedures	Measured and calculated through baseline measurement campaign
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	$FC_{gen}^{BL,fuel}$
Unit	m^3/year
Description	Historical average amount of natural gas consumption of generators for electricity generation.
Source of data	Project participants
Value(s) applied	72,000
Choice of data or Measurement methods and procedures	Collecting from United Power generation and Distribution that supplies power to the factory. Data for the past three years is preferable; at least one-year vintage data is necessary.
Purpose of data	Used to calculate the baseline emissions
Additional comment	Data for 8 hours in 2012

Data / Parameter	$EG_{gen}^{BL,fuel}$
Unit	kWh/year
Description	Historical average of electricity generated from generators (kWh/year).
Source of data	Project participants
Value(s) applied	280,000
Choice of data or Measurement methods and procedures	Collecting from United Power generation and Distribution that supplies power to the factory. Data for the past three years is preferable; at least one-year vintage data is necessary.
Purpose of data	Used to calculate the baseline emissions
Additional comment	Data for 8 hours in 2012

Data / Parameter	NCV_{gen}^{fuel}
Unit	TJ/Gg
Description	Net caloric value of natural gas used for generators
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	46.5
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	De_{gen}^{fuel}
Unit	kg/m^3
Description	Density of natural gas used for generators
Source of data	FINAL REPORT ON EMISSION INVENTORY, BANGLADESH COUNTRY STUDY, ASIA LEAST-COST GREENHOUSE GAS ABATEMENT STRATEGY (ALGAS)
Value(s) applied	0.72
Choice of data or Measurement methods and procedures	The value used for Bangladesh case
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	$EF_{CO2}^{fuel,gen}$
Unit	kg-CO_2/TJ
Description	CO_2 emission factor of natural gas for generators
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	56,100
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Used to calculate the baseline emissions
Additional comment	-

Data / Parameter	$SP_{steam}^{BL,fuel}$
Unit	Ton-steam/year
Description	Historical amount of steam produced from boilers.
Source of data	Project implementer
Value(s) applied	15,000
Choice of data or Measurement methods and procedures	Calculated based on the data collected at the factory. Data for the past three years is preferable; at least one year vintage data is necessary
Purpose of data	Used to calculate the baseline emissions
Additional comment	Assumed data for 2011

Data / Parameter	$FC_{steam}^{BL,fuel}$
Unit	m^3/year
Description	Historical fuel consumption of boilers.
Source of data	Project implementer
Value(s) applied	3,275,639
Choice of data or Measurement methods and procedures	Calculated based on the data collected at the factory. Data for the past three years is preferable; at least one year vintage data is necessary
Purpose of data	Used to calculate the baseline emissions
Additional comment	Actual data for 2011

D.6.3. Ex-ante calculation of emission reductions

For ex-ante calculation of emission reduction from the CPA, the following assumptions are considered with the data in hand at the moment.

- Number of batches 5,000 in 2013.
- One type of dyeing machine (Athena with 100 Kg capacity)
- 95% fabric load
- Among the batches 70% fro cotton (80% dark, 10% medium and 10% light colour), 10% for CVC (80% dark, 10% medium and 10% light colour) 20% for polyester (80% dark, 10% medium and 10% light colour).

<u>Baseline Emissions</u>

As mentioned before, the baseline scenario for the project is the continuation of current dyeing process (Mainly conventional reactive dyeing) in the factory.

The baseline emission can be calculated based on the following equation.

$$BE_y = (EC_{Dyeing,y}^{BL} + EC_{Water,y}^{BL}) \times EF_{CO2}^{BL,elec} + SC_y^{BL} \times EF_{CO2}^{BL,steam} \qquad (1)$$

Where:

BE_y	Baseline emissions in a year y (CO_2 ton/year)
$EC_{Dyeing,y}^{BL}$	Baseline electricity consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year y (1,154,250 kWh/year)
$EC_{Water,y}^{BL}$	Baseline electricity consumption by pumping of fresh water that used in dyeing machines in year y (202,834 kWh/year).
SC_y^{BL}	Baseline steam consumption by dyeing machines to which the water and energy saving technologies will be introduced by the CPA in year y (30,947 ton-steam/year)
$EF_{CO2}^{BL,elec}$	CO_2 emission factor of electricity generation for the factory (0.449 ton CO_2/MWh)

$EF_{CO2}^{BL,steam}$	CO_2 emission factor for the steam generation for the factory (0.382 ton CO_2/ton-steam)

BE_y = (1,154,250 + 202,834)/1000*0.483 + 30,947* 0.41 = 13,344 ton CO_2/year

$$EC_{Dyeing,y}^{BL} = \sum_i \sum_j \sum_k \sum_l EC_{i,j,k,l}^{BL,Batch,dyeing} \times NB_{i,j,k,l,y}^{PJ} \quad (2)$$

Where:

$EC_{Dyeing,y}^{BL}$	Baseline electricity consumption by dyeing processes in year *y* (kWh/year)
$EC_{i,j,k,l}^{BL,Batch,dyeing}$	Historical average electricity consumption of a dyeing machine *i* for a batch in the baseline dyeing process for brightness of colour *j* material *k* at a load-type of *l* (kWh/batch). Machine: Sclavos Unit: kWh/batch Load capacity: 95% <table><tr><th>$EC_{i,j,k,l}^{BL,Batch,dyeing}$</th><th>Light</th><th>Medium</th><th>Dark</th></tr><tr><td>**Cellulose**</td><td>238</td><td>238</td><td>257</td></tr><tr><td>**CVC**</td><td>273</td><td>280</td><td>316</td></tr><tr><td>**Polyester**</td><td>89</td><td>99</td><td>119</td></tr></table>
$NB_{i,j,k,l,y}^{PJ}$	Numbers of batches on a dyeing machine *i* in the project dyeing process for brightness of color *j* material *k* at a load *l* in a year y. For per machine 700 batches for cotton (560 batches for dark, 70 batches for medium and light respectively), 100 batches for CVC (80 batches for dark, 10 batches for medium and light respectively) and 200 batches for polyester (160 batches for dark, 20 batched for medium and light respectively).
i	Types of dyeing machines in the factory. 5 Sclavos machines with 1000 kg capacity
j	Brightness of color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Type of load for dyeing machine in the factory (95% for all machines)

$EC_{Dyeing,y}^{BL}$= [(257*560+238*70+238*70)+(316*80+280*10+273*10)+(119*160+99*20+89*20)]*5

= 1,154,250 kWh/year

$$EC^{BL}_{Water,y} = \sum_{i}\sum_{j}\sum_{k}\sum_{l} WC^{BL,Batch}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \times EC^{BL,pumping}_{clean,water} \quad (3)$$

Where:

<table>
<tr><td>$EF^{BL}_{Water,y}$</td><td>Baseline electricity consumption by pumping of water that used in dyeing machines in year y (kWh/year)</td></tr>
<tr><td>$WC^{BL,Batch}_{i,j,k,l}$</td><td>Historical average water consumption in machine i for a batch in the baseline dyeing process for colour j material k at a load of l (Litre/batch)
<table>
<tr><th>$WC^{BL,Batch}_{i,j,k,l}$</th><th>Light</th><th>Medium</th><th>Dark</th></tr>
<tr><td>Cellulose</td><td>87,200</td><td>94,400</td><td>105,200</td></tr>
<tr><td>CVC</td><td>105,600</td><td>105,600</td><td>123,600</td></tr>
<tr><td>Polyester</td><td>40,400</td><td>40,400</td><td>51,200</td></tr>
</table></td></tr>
<tr><td>$NB^{PJ}_{i,j,k,l,y}$</td><td>Number of batches on a machine i in the project dyeing for color j material k at a load of l in a year y.
For per machine 700 batches for cotton (560 batches for dark, 70 batches for medium and light respectively), 100 batches for CVC (80 batches for dark, 10 batches for medium and light respectively) and 200 batches for polyester (160 batches for dark, 20 batched for medium and light respectively).</td></tr>
<tr><td>$EC^{BL,pumping}_{freash,water}$</td><td>Historical average electricity consumption for pumping underground water (kWh/liter).
Assume 0.2 kWh/m^3 at the water supply system of the DEPZ.</td></tr>
<tr><td>i</td><td>Type of dyeing machines in the factory (5 Sclavos machines with 1000 kg capacity)</td></tr>
<tr><td>j</td><td>Color of textile being dyed in the factory (j: light, medium, dark)</td></tr>
<tr><td>k</td><td>Type of textile being dyeing in the factory (k: cellulose, CVC and polyester)</td></tr>
<tr><td>l</td><td>Different load for dyeing a machine in the factory (95% for all machines)</td></tr>
</table>

$EF^{BL}_{Water,y}$= [(105.200*560+94.400*70*87.200*70)+(123.600*80+105.600*10+105.600*10)+ (51.200*160+40.400+20+40.400*20)]*5*0.2

= 202,834 kWh/year

$$SC^{BL}_{y} = \sum_{i}\sum_{j}\sum_{k}\sum_{l} SC^{BL,Batch}_{i,j,k,l} \times NB^{PJ}_{i,j,k,l,y} \quad (4)$$

Where:

SC^{BL}_{y}	Baseline steam consumption by dyeing processes in year y (ton/year)
$SC^{BL,Batch}_{i,j,k,l}$	Historical average steam consumption of a dyeing machine i for a batch in the baseline dyeing process for colour j material k at a load-type of l (ton-steam/batch)

Machine: Sclavos
Unit: kg-steam/batch
Load capacity: 95%

SP^{fuel}_{steam}	Light	Medium	Dark
Cellulose	5,797	6,348	6,969
CVC	6,570	65,70	7,672
Polyester	2,902	2,930	3,592

$NB^{PJ}_{i,j,k,l,y}$	Number of batches on a machine *i* in the project dyeing for color *j* material *k* at a load-type of *l* in a year *y*. For per machine 700 batches for cotton (560 batches for dark, 70 batches for medium and light respectively), 100 batches for CVC (80 batches for dark, 10 batches for medium and light respectively) and 200 batches for polyester (160 batches for dark, 20 batched for medium and light respectively).
i	Type of dyeing machines in the factory (5 Sclavos machines with 1000 kg capacity)
j	Brightness of color of textile being dyed in the factory (*j*: light, medium, dark)
k	Type of textile being dyeing in the factory (*k*: cellulose, CVC and polyester)
l	Type of load for dyeing machine in the factory (95% for all machines)

SC^{BL}_{y}= [(6,969*560+6,348*70+5,797*70)+(7,672*80+6,570*10+6,570*10
+(3,592*160+2,930*20+2,902*20)]/1,000*5
=30,947 ton-steam/year

$$EF^{BL,elec}_{CO2} = \frac{FC^{BL,fuel}_{gen} \times De^{fuel}_{gen} \times NCV^{fuel}_{gen} \times EF^{fuel,gen}_{CO2}}{EG^{BL,fuel}_{gen}} \qquad (5)$$

Where:

$EF^{BL,elec}_{CO2}$	CO_2 emission factor of electricity generation for the factory (ton CO_2/MWh)
$EG^{BL,fuel}_{gen}$	Historical average of electricity generated from generators (kWh/year). Data for the past three years is preferable; at least one-year vintage data is necessary. 280,000 kWh/8 hours (United Power generation and Distribution)
$FC^{BL.fuel}_{gen}$	Historical natural gas consumption average of generators (m^3/year). Data for the past three years is preferable; at least one-year vintage data is necessary. 72,000 m^3/8 hours (United Power generation and Distribution)
NCV^{fuel}_{gen}	Net caloric value of the natural gas used for generators (T46.5 J/Gg). IPCC default value
De^{fuel}_{gen}	Density of the fuel for generators (0.72 kg/m^3). IPCC default value
$EF^{fuel,gen}_{CO2}$	CO_2 emission factor of the natural gas for generators (56,100 kg-ton CO_2/TJ) IPCC default value

$EF^{BL,elec}_{CO2}$= 0.483 ton CO_2/MWh

$$EF_{CO2}^{BL,steam} = \frac{FC_{boiler}^{BL,fuel} \times De_{boiler}^{fuel} \times NCV_{boiler}^{fuel} \times EF_{CO2}^{fuel,boiler}}{SP_{boiler}^{BL,fuel}} \quad (6)$$

Where:

$EF_{CO2}^{BL,steam}$	CO_2 emission factor for the steam generation (ton CO_2/ton steam)
$SP_{steam}^{BL,fuel}$	Historical amount of steam produced from boilers (ton-steam/year). Data for the past three years is preferable; at least one-year vintage data is necessary. Assume 15,000 ton-steam for 2011
$FC_{steam}^{BL,fuel}$	Historical natural gas consumption of boilers (m^3/year). Data for the past three years is preferable; at least one-year vintage data is necessary. 3,275,639 m^3 for 2011
NCV_{steam}^{fuel}	Net caloric value of the fuel used for boilers (TJ/Gg)
De_{steam}^{fuel}	Density of the fuel for boilers (kg/m^3)
$EF_{CO2}^{fuel,boiler}$	CO_2 emission factor of the fuel for boilers (kg-ton CO_2/TJ)

$EF_{CO2}^{BL,steam}$= 0.41 ton CO_2/ton-steam

Project Emissions

$$PE_y = (EC_{Dyeing,y}^{PJ} + EC_{Water,y}^{PJ}) \times EF_{CO2}^{PJ,elec} + SC_y^{PJ} \times EF_{CO2}^{PJ,steam} \quad (7)$$

Where:

PE_y	Project emission in a year y (CO_2 ton/year)
$EC_{Dyeing,y}^{PJ}$	Project emission from electricity consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (kWh/year).
$EF_{Water,y}^{PJ}$	Project emission from electricity consumption by pumping of water that used in dyeing machines in the factory in year y (kWh/year)
SC_y^{PJ}	Project emission from steam consumption by dyeing machines to which water and energy saving technologies introduced by the CPA in year *y* (ton-steam /year)
$EF_{CO2}^{PJ,elec}$	CO_2 emission factor of electricity generation for the factory (Assume 0.449 ton CO_2/MWh)
EF_{CO2}^{steam}	CO_2 emission factor for the steam generation for the factory (Assume 0.382 ton CO_2/ton-steam)

As the project is seen to cut electricity consumption by 75% and steam consumption by 50%, the project CO_2 emission can be estimates as follows.

PE_y = (1,154,250 + 202,834)/1000*0.483*0.25 + 30,947* 0.41*0.5
= 6,508 ton CO_2/year

Leakage

There are no leakage emissions identified for this type of project.
Therefore:

$$L = 0 \quad (13)$$

Emission Reduction

$$ER_y = BE_y - PE_y \quad (14)$$

Where:

ER_y	Emission reduction in year y (ton/year)
BE_y	Baseline emission in a year y (13,344 CO_2 ton/year)
PE_y	Project emission in a year y (6,508CO_2 ton/year)

ER_y = 13,344 – 6,508 = 6,836 Ton/year

D.6.4. Summary of the ex-ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
1/6/2013	13,344	6,508	0	6,836
1/6/2014	13,344	6,508	0	6,836
1/6/2015	13,344	6,508	0	6,836
1/6/2016	13,344	6,508	0	6,836
1/6/2017	13,344	6,508	0	6,836
1/6/2018	13,344	6,508	0	6,836
1/6/2019	13,344	6,508	0	6,836
1/6/2020	13,344	6,508	0	6,836
1/6/2021	13,344	6,508	0	6,836
1/6/2022	13,344	6,508	0	6,836
Total	133,440	65,080	0	68,360
Total number of crediting years	10 years			
Annual average over the crediting period	13,344	6,508	0	6,836

D.7. Application of the monitoring methodology and description of the monitoring plan

D.7.1. Data and parameters to be monitored

The following data should be monitored.

<table>
<tr><td>Data / Parameter</td><td>$NB_{i,j,k,l,y}^{PJ}$</td></tr>
<tr><td>Unit</td><td>Number</td></tr>
<tr><td>Description</td><td>Number of batches on a machine i in the project dyeing for color j material k at a load of l in a year y</td></tr>
<tr><td>Source of data</td><td>Project implementer</td></tr>
<tr><td>Value(s) applied</td><td>Machine: Sclavos
Unit: Batch/machine
Load capacity: 95%
<table>
<tr><td>Number of Batches</td><td>Light</td><td>Medium</td><td>Dark</td></tr>
<tr><td>Cellulose</td><td>70</td><td>70</td><td>560</td></tr>
<tr><td>CVC</td><td>10</td><td>10</td><td>80</td></tr>
<tr><td>Polyester</td><td>20</td><td>20</td><td>160</td></tr>
</table></td></tr>
<tr><td>Measurement methods and procedures</td><td>Aggregation of daily records in the factory.</td></tr>
<tr><td>Monitoring frequency</td><td>Project implementer aggregate the daily-recorded data monthly</td></tr>
<tr><td>QA/QC procedures</td><td>It is mandatory for dyeing maters to record every batch in each machine in terms of fabric load, fabric type and fabric colour.</td></tr>
<tr><td>Purpose of data</td><td>For calculating project energy and water consumption</td></tr>
<tr><td>Additional comments</td><td>Estimated values</td></tr>
</table>

Data / Parameter	$EC_{i,j,k,l}^{PJ,Batch,dyeing}$
Unit	kWh/batch
Description	Electricity consumption of a machine *i* for a batch in the project dyeing process for color *j* material *k* at a load of *l* in a year y
Source of data	Project implementer
Value(s) applied	Machine: Sclavos Unit: kWh/batch Load capacity: 95%
Measurement methods and procedures	Measuring through electric meters installed at points of power lines to each dyeing machine at the factory. Dyeing masters read and record electricity consumption from electric meters for each batch and the CME aggregates the data monthly from the factory where the data recorded for each batch by dyeing masters.
Monitoring frequency	For each batch.
QA/QC procedures	Calibrations of electric power meters will be conducted as per related national regulations and international standards.
Purpose of data	For calculating project emission from electricity consumption
Additional comments	The values given above are estimated values

$EC_{i,j,k,l}^{PJ,Batch,dyeing}$	**Light**	**Medium**	**Dark**
Cellulose	59	59	64
CVC	68	70	79
Polyester	22	24	29

Data / Parameter	$WC_{i,j,k,l}^{PJ,Batch}$
Unit	Litre/batch
Description	Water consumption of a machine *i* for a batch in the project dyeing process for colour *j* material *k* at a load of *l*
Source of data	Project implementer
Value(s) applied	Machine: Sclavos Unit: Liter/batch Load capacity: 95%
Measurement methods and procedures	Measuring and calculating based on water tanks of the machines, bath ratios and performed dyeing charts. The CME aggregates the data monthly from the factory where the data recorded for each batch by dyeing masters.
Monitoring frequency	For each batch.
QA/QC procedures	Calculated data based on the performed dyeing charts of machines is believed to be a conservative value.
Purpose of data	For calculating project emission from water consumption
Additional comments	The values given above are estimated values

$WC_{i,j,k,l}^{PJ,Batch}$	**Light**	**Medium**	**Dark**
Cellulose	43,600	47,200	52,600
CVC	52,800	52,800	61,800
Polyester	20,200	20,200	26,600

Data / Parameter	$SC_{i,j,k,l}^{PJ,Batch}$
Unit	To-steam/batch
Description	Steam consumption of a machine *i* for a batch in the project dyeing process for colour *j* material *k* at a load of *l* (ton-steam /batch)
Source of data	Project implementer
Value(s) applied	Machine: Sclavos Unit: kg-steam/batch Load capacity: 95% <table><tr><th>$SC_{i,j,k,l}^{PJ,Batch}$</th><th>Light</th><th>Medium</th><th>Dark</th></tr><tr><td>**Cellulose**</td><td>2,899</td><td>3,174</td><td>3,485</td></tr><tr><td>**CVC**</td><td>3,285</td><td>3,285</td><td>3,836</td></tr><tr><td>**Polyester**</td><td>1,451</td><td>1,465</td><td>1,796</td></tr></table>
Measurement methods and procedures	Measuring through steam meters installed at the points of steam pipes for each dyeing machine. Dyeing masters read and record electricity consumption from electric meters for each batch and the CME aggregates the data monthly from the factory where the data recorded for each batch by dyeing masters.
Monitoring frequency	For each batch.
QA/QC procedures	Crosschecking with a calculated data based on the performed dyeing charts of machines in the factory. Steam meters will be calibrated as per related national regulations and international standards
Purpose of data	For calculating project emission from steam consumption
Additional comments	The values given above are estimated values

Data / Parameter	$EC_{fresh,water}^{PJ,pumping}$
Unit	kWh/litre
Description	Electricity consumption for pumping groundwater in the water supply system
Source of data	Project implementer
Value(s) applied	0.2
Measurement methods and procedures	Calculating based on the collected data from the water supply system of the SEPZ.
Monitoring frequency	Monthly
QA/QC procedures	Official data of the DEPZ
Purpose of data	For calculating project emission from water consumption
Additional comments	The values given above are estimated values

Data / Parameter	$EG_{gen}^{PJ,fuel}$
Unit	MWh/year
Description	Amount of electricity generated from generators in a year y
Source of data	Project implementer
Value(s) applied	306,600
Measurement methods and procedures	Collecting from United Power generation and Distribution
Monitoring frequency	Monthly
QA/QC procedures	Official data from United Power generation and Distribution Company
Purpose of data	For calculating CO_2 emission factor for electricity generation
Additional comments	The values given above are estimated values

Data / Parameter	$FC_{gen}^{PJ.fuel}$
Unit	m^3/year
Description	Amount of fuel consumed by generators for electricity generation in a year y
Source of data	Project implementer
Value(s) applied	78,840,000
Measurement methods and procedures	Collecting from United Power generation and Distribution
Monitoring frequency	Monthly
QA/QC procedures	Official data from power provider the United Power generation and Distribution Company.
Purpose of data	For calculating CO_2 emission factor for electricity generation
Additional comments	The values given above are estimated values

Data / Parameter	$SP_{steam}^{PJ,fuel}$
Unit	Ton-steam/year
Description	Amount of steam produced by boilers in a year y
Source of data	Project implementer
Value(s) applied	15,000
Measurement methods and procedures	Measuring through steam flow meters installed at the points of steam delivery pipes from the boilers.
Monitoring frequency	Monthly
QA/QC procedures	Crosschecking with the data calculated based on the boiler operation data. Steam meters will be calibrated as per related national regulations and international standards
Purpose of data	For calculating CO_2 emission factor for steam generation
Additional comments	The values given above are estimated values

Data / Parameter	$FC_{steam}^{PJ,fuel}$
Unit	m^3/year
Description	Amount of fuel consumed by boilers for steam generation in a year y
Source of data	Project implementer
Value(s) applied	3,275,639
Measurement methods and procedures	Measuring through gas meters that installed at the points of gas pipes for boilers.
Monitoring frequency	Monthly
QA/QC procedures	Crosschecking with gas purchase bills. Gas flow meters will be calibrated as per related national regulations and international standards
Purpose of data	For calculating CO_2 emission factor for steam generation
Additional comments	The values given above are estimated values

D.7.2. Description of the monitoring plan

According to the AMS-II.D (version 12), the energy consumption for industrial process is required to be monitored though meters, the monitoring plan is developed to ensure the monitoring of the energy consumptions and calculating energy savings using the monitored and other necessary data and information through identifying different stakeholders responsibility, stipulating quality assurance systems and emphasizing recording and reporting systems. The monitoring plan is unfolded as follows.

(1) Monitoring Framework

The W.S.T will act as the overall supervisor and prepare a monitoring report periodically (typically annually) to the DOE based on the data and information reported by the project implementer, GK.

The CPA implementer, GK will undertake the monitoring (especially preparing the monthly and annual status report) based on the operation and monitoring manual prepared by W.S.T.
The W.S.T has a responsibility to manage and operate the CPA.

(2) The Function of CME and the CPA Implementer

The following table shows the roles of the CME and the project implementer for the monitoring.

	CME (W.S.T supported by PEAR)	GK
Monitoring management	- Develop the operation and monitoring manual for activities. - Develop and establish data collection and reporting system for parameters monitored in every CPAs.	- Implement and manage monitoring of the project activities

	- Implement and manage monitoring of CPAs.	
Data collection	- Establish and maintain data collection systems for parameters monitored. - Check data quality and collection procedures regularly.	- Implement data collection; especially after the project implementation. - Check internal data quality and collection procedures regularly
Data storage and management	- Develop database format of CPA. - Check the reported data from each CPAs. - Calculate emission reductions based on the data reported by the implementers. - Implement data management of CPAs. - Store and maintain records.	- Enter collected data to a computer database. - Implement data management of the activities. - Store and maintain records. - All of the monitoring parameters under the monitoring plan would be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever is later
Communication and reporting	- Analyse data and compare project performances. - Prepare and forward monthly or annual reports.	- Monthly report electronic data to the CME
CDM training and capacity building	- Develop and establish training program for implementers - Organize regular internal audit for collected data	- Implement internal training for staffs on the monitoring - Conduct internal audit for all recorded data twice year
Quality assurance and verification	- Develop a monitoring manual includes quality assurance systems such as calibration procedures for various meters and crosschecks with a view to ensuring transparency and allowing for verification. - Prepare for, facilitate and coordinate verification process.	- Undertake regular check internal of data collection - All of information are recorded and reported to CME. - Ensure regular calibration of electric power meters, steam flow meters and other related measures.

(3) Monitored Data

The data to be monitored are described in section D.7.1 above.

(4) Data Collection

Data collection is conducted by both of the W.S.T and the project implementer.
The W.S.T will collect data from the project implementer and check the quality of the data reported. The project implementer is mainly in charge of data collection from its own factory and from other sources.

SECTION E. Approval and authorization

The applications for Bangladesh and Japanese Government approvals will be conducted during the validation and approval letters from both countries should be obtained before submitting application for registration.

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Appendix 1: Contact information on entity/individual responsible for the CPA

Organization	Grameen Knitwear Ltd.
Street/P.O. Box	Mirpur-2
Building	Grameen Bank Complex
City	Dhaka
State/Region	
Postcode	1216
Country	Bangladesh
Telephone	880-2-8054034
Fax	880-2-8050395
E-mail	gknit@grameen.com
Website	www.grameenknitwear.com/
Contact person	Ashraful Hassan
Title	Managing Director
Salutation	Mr.
Last name	Hassan
Middle name	
First name	Ashraful
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	aashraf@grameentelecom.net.bd

Organization	Green Project W.S.T
Street/P.O. Box	Sonargaon Janapath Road
Building	KC Tower
City	Dhaka
State/Region	Uttara
Postcode	1230
Country	Bangladesh
Telephone	880-2-8054034
Fax	880-2-8050395
E-mail	info@greenproject-wst.com
Website	www.greenproject-wst.com
Contact person	Wolfram Engel
Title	President and CEO
Salutation	Dr.
Last name	Engel
Middle name	
First name	Wolfram
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	engel.consulting.hk@gmail.com

Organization	PEAR Carbon Offset Initiative, Ltd.
Street/P.O. Box	1-10-11 Tsukuji
Building	1002 RATIO
City	Chuo-ku
State/Region	Tokyo
Postcode	104-0045
Country	Japan
Telephone	+81-3-3248-0557
Fax	+81-3-3248-0557
E-mail	n_matsuo@pear-carbon-offset.org
Website	http://www.pear-carbon-offset.org
Contact person	Naoki Matsuo
Title	CEO
Salutation	Dr.
Last name	Matsuo
Middle name	
First name	Naoki
Department	
Mobile	+81-90-9806-0723
Direct fax	
Direct tel.	
Personal e-mail	n_matsuo@pear-carbon-offset.org

Appendix 2: Affirmation regarding public funding

The CPA does not use any public fund.

Appendix 3: Applicability of the selected methodology (ies)

The applicability of the small-scale methodology, AMS II.D has been detailed in the section D.2.

Appendix 4: Further background information on ex ante calculation of emission reductions

The water and energy (electricity and steam) consumption for baseline are measured and calculated by W.S.T together with Japan Textile Consultant Center (JTCC) through an auditing that was conducted during 8~13 August 2012 toward the GK factory. The electricity consumption for batches are calculated based on the operation powers measured and times of operation while water and steam consumption are calculated as per performed dyeing charts that is judged by experts and machine makers as a very conservative way for baseline water and energy consumption.

The following are the water and energy consumptions for the 5 Sclavos machines in the case of 95% fabric load capacity.

Machine: ATHENA (with 1000 kg capacity)
Unit: kWh/batch
Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	**Light**	**Medium**	**Dark**
Cellulose	238	238	257
CVC	273	280	316
Polyester	89	99	119

Machine: HT-4 (with 720 kg capacity)
Unit: kWh/batch
Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	**Light**	**Medium**	**Dark**
Cellulose	148	148	160
CVC	170	174	197
Polyester	55	62	74

Machine: HT-3 (with 720 kg capacity)
Unit: kWh/batch

Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	Light	Medium	Dark
Cellulose	141	141	153
CVC	162	166	188
Polyester	53	59	71

Machine: AT-4 (with 540 kg capacity)
Unit: kWh/batch
Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	Light	Medium	Dark
Cellulose	162	162	175
CVC	185	190	215
Polyester	60	67	81

Machine: HT-1 (with 180 kg capacity)
Unit: kWh/batch
Load capacity: 95%

$EC_{i,j,k,l}^{BL,Batch,dyeing}$	Light	Medium	Dark
Cellulose	81	81	87
CVC	93	95	107
Polyester	30	34	40

Machine: ATHENA (with 1000 kg capacity)
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	Light	Medium	Dark
Cellulose	87,200	94,400	105,200
CVC	105,600	105,600	123,600
Polyester	40,400	40,400	51,200

Machine: HT-4 (with 720 kg capacity)
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	Light	Medium	Dark
Cellulose	82,944	90,144	100,944
CVC	99,216	93,366	117,216
Polyester	34,416	31,491	45,216

Machine: HT-3 (with 720 kg capacity)
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	Light	Medium	Dark
Cellulose	82,944	90,144	100,944
CVC	99,216	93,366	117,216
Polyester	34,416	31,491	45,216

Machine: AT-4 (with 540 kg capacity)
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	**Light**	**Medium**	**Dark**
Cellulose	80,208	87,408	98,208
CVC	95,112	95,112	113,112
Polyester	30,312	28,755	41,112

Machine: HT-1 (with 180 kg capacity)
Unit: Liter/batch
Load capacity: 95%

$WC_{i,j,k,l}^{BL,Batch}$	**Light**	**Medium**	**Dark**
Cellulose	74,736	81,936	92,736
CVC	86,904	86,904	104,904
Polyester	22,104	23,283	31,904

Machine: ATHENA (with 1000 kg capacity)
Unit: ton-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	5,797	6,348	6,969
CVC	6,570	65,70	7,672
Polyester	2,902	2,930	3,592

Machine: HT-4 (with 720 kg capacity)
Unit: ton-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	5,359	6,000	6,540
CVC	5,860	5,457	6,962
Polyester	2,280	1,989	2,964

Machine: HT-3 (with 720 kg capacity)
Unit: ton-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	5,359	6,000	6,540
CVC	5,860	5,457	6,962
Polyester	2,280	1,989	2,964

Machine: AT-4 (with 540 kg capacity)
Unit: ton-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	5,163	5,715	6,328
CVC	5,532	5,532	6,635
Polyester	1,958	1,810	2,638

Machine: HT-1 (with 180 kg capacity)
Unit: ton-steam/batch
Load capacity: 95%

SP_{steam}^{fuel}	**Light**	**Medium**	**Dark**
Cellulose	4,713	5,265	5,861
CVC	4,789	4,789	5,892
Polyester	1,257	1,395	1,930

Appendix 5: Further background information on monitoring plan

Please refer to section D.7 of the document

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History of the document

Version	Date	Nature of revision(s)
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the component project activity design document form" (EB 66, Annex 16).
01	EB33, Annex42 27 July 2007	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		