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

CONTENTS

Annexes

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:

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Title: Energy efficiency measures in "Technopolis".

Version: 01

Date: 07/05/2007

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

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The project activity involves energy efficiency measures undertaken by Phoenix Software Limited (PSL) in an Information Technology (IT) space in the name of "Technopolis"**.**

The energy efficiency measures have been undertaken primarily in the Heating, Venting and Air-Conditioning (HVAC) system of "Technopolis". The measures adopted in the HVAC system result in reduction in electrical energy consumption, in comparison to that for a building for IT and IT enabled services with similar size (in terms of floor area, carpet area and number of storeys), capacity (in terms of occupancy) and architectural perspectives.

The energy efficiency measures taken in the HVAC system affect the electricity consumption in two major ways – (i) by reducing the design heat load in the building which in turn reduces the power requirement of the HVAC system and (ii) by reducing variable heat load and the electrical energy consumption by equipping the HVAC system to operate at variable loads through installation of variable frequency drives (VFDs). The following table provides details of the proposed installations and energy efficiency measures taken in "Technopolis" vis-à-vis the measures that would be taken in a conventional IT building (defined as the baseline building in Section B.3).

Table A.1

Parameters affecting the HVAC system	**Baseline Building**	**Energy efficiency measures in 'Technopolis' building**	**Remarks/ Comments**
Comparison of various energy efficiency measures adopted in "Technopolis" which will impact the Design Heat Load and Power Consumption of the HVAC System- Fixed reduction in Heat Load and Power Consumption of HVAC system of Technopolis			
Exterior wall construction	The wall would have been mass wall of U factor of 1.0 Btu/hr.ft^2 .^{0}F	The wall is 9" thick brick wall with plaster inside and outside, effective U value of 0.32 Btu/hr.ft^2 .^{0}F	The measure taken in the exterior wall construction of "Technopolis" result in a reduction in the designed heat load of the HVAC system.
Exposure of glass wall area	(i) The glasses used would be plain glass. (ii) The U-value of the fenestration would be 1.0 Btu/hr.ft^2 .^{0}F on the north and non-north sides. (iii) The glass would have shading co-efficient of 0.656 on all sides. (iv) The glass would have 70% visible light transmittance on all sides. (v) There would be no insulation in the space between the spandril and the	(i) The glazing used in the building is of high performance double glazed panels coated with reflective low "e"-glass panes and having low U-value and solar heat gain co-efficient. (ii) The U-value of the fenestration is 0.27 Btu/hr.ft^2 .^{0}F on the north and 0.41 Btu/hr.ft^2 .^{0}F on the non-north sides. (iii) High quality imported glass (with shading co-	The measures taken in the glazing of "Technopolis" result in a reduction in the designed heat load of the HVAC system.

Parameters affecting the HVAC system	Baseline Building	Energy efficiency measures in 'Technopolis' building	Remarks/ Comments
	sill areas	efficient of 0.15 on the north side and 0.12 on the non-north sides), has been used. (iv) The fenestration has a visible light transmittance of 23% on the north and 6% on the non-north sides (v) The space between the spandril and the sill areas is insulated with mineral wool to reduce heat influx in to the building.	
Roof Insulation	(i)The U-value of the roof would be 0.63 Btu/hr-ft^{2}-^{0}F with R-15 over-deck insulation. (ii) Roof reflectivity would be 0.3. (iii)No terrace gardening would be there.	(i)The U-value of the roof is 0.052 Btu/hr-ft^{2}-^{0}F with R-15 extruded polystyrene insulation. (ii) Roof reflectivity would be 0.3. (iii)Terrace gardening has been done to provide additional insulation for the roof, as a result of which island heat effect will be reduced. The evapo-transpiration effect due to the terrace garden will also	The measures taken in the roof of "Technopolis" result in a reduction in the designed heat load of the HVAC system.

Parameters affecting the HVAC system	Baseline Building	Energy efficiency measures in 'Technopolis' building	Remarks/ Comments
		contribute to keeping the building cool during summer season.	
Air Handling Unit (AHU)	There would be no Heat Recovery Wheel (HRW).	Each Air Handling Unit (AHU) room has a Heat Recovery Wheel (HRW) with a supply air fan and return air fan. The highly efficient HRW, which is efficient on both sensible and latent heat loads, enables further reduction in the heat load to be handled by the HVAC system.	The HRWs installed in the AHUs of "Technopolis" result in a reduction in the designed heat load and in the specific power consumption in kW/TR taking into account the seasonal variations.
Chillers	(i)To meet the load demand, air cooled chillers with a full load efficiency of 1.17 kW/ton of refrigeration [kW/TR] (a co-efficient of performance i.e. COP of 3.0 at ARI conditions) would be used. (ii)Therefore, there would be no requirement for a cooling tower	(i)To meet the load demand, 2 water-cooled centrifugal chillers with full load efficiency of 0.576 kW/TR (COP of 6.1 at ARI conditions) are installed & a water-cooled screw chiller with COP of 5.5, has been kept as a standby. (ii) There is cooling tower with VFDs on the fans	With the installation of efficient chillers,, the specific power consumption in kW/TR of the HVAC system is reduced.

Comparison of various energy efficiency measures adopted in 'Technopolis' which will impact the Heat Load and Power Consumption of the HVAC System based on the demand- Variable reduction in Heat Load and Electricity Consumption of HVAC system of Technopolis			
Installation of VFD in the AHU	The AHUs would have provision for fresh air intake. The volume of fresh air planned would be 20ft^3/min (cfm) per person. Based on the occupancy planned, the quantity of fresh air brought in to the building would be approximately 100000 cfm which would be handled by the AHU coils on a continuous basis.	The AHUs have provision for fresh air intake. The volume of fresh air planned is 20 cfm per person but is modulated based on CO_2 sensors in the occupied zones. Based on the CO_2 differential the quantity of fresh air brought in to the building is varied using the VFDs. This may reduce the quantity of fresh air required to be handled, thereby reducing the heat load on the HVAC System. Moreover each HRW has a supply air fan and return air fan, both operating with VFDs, thereby reducing the electricity consumption of the respective fans corresponding to the variance in the quantity of air being handled by the AHUs.	The VFDs in the AHUs of "Technopolis" result in a reduction in the variable heat load of the HVAC system and those in the HRWs reduce the electricity consumption of the fans operating at lower frequencies.
Installation of VFDs in the chilled water	Chilled water would be pumped with a primary-secondary pumping	Chilled water is pumped with a primary-secondary pumping arrangement. The primary	VFD installation in the chilled water pumping system

pumping system	arrangement. The primary loop pumps would circulate chilled water through the chillers, and the secondary pumps would distribute chilled water to the building. When the primary pumps, with motors operating at constant speeds are selected, they invariably have some extra head in the pump selection as compared to that of the actual demand at site. A balancing valve would be used after the chiller plant in order to introduce this non existing head in the primary loop. The electricity consumption of the pumps in the primary chilled water loop, therefore, would remain the same. However, VFDs would be installed in the secondary chilled water loop, to accommodate the variations in the building demand. The chilled water system would be designed for 2.67 Gallons/per minute (GPM) flow per TR.	loop pumps circulate chilled water through the chillers, and the secondary pumps distribute chilled water to the building. VFDs are installed both in the primary and secondary chilled water loops. VFD in the primary pump is used to reduce the speed of the pump while a balancing valve after the chiller plant, is kept fully open. The electricity consumption of the pumps in the primary chilled water loop, can thus be varied by operating the pump motors at lower frequencies. VFDs in the pumps of secondary chilled water loop accommodate the variations in the chilled water demand depending on the quantity of air being handled by the AHUs of the building. The chilled water system is designed for 1.9 GPM flow per TR.	results in reduction in electricity consumption. VFDs installed at secondary pumping system of the chillers are found to be a common practice. Hence the reduction in electricity consumption from the same is not considered for computation of emission reductions. However, VFDs installed in the primary pumping system of chillers, is not a business-as-usual scenario. So the reduction in electricity consumption from the same has not been considered for computation of emission reductions.

Unlike other IT buildings, the main power shall be fed from two sources, one from 132 kilo Volt (kV) substation of West Bengal State Electricity Board (WBSEB) and the other from 33 kV substation of West Bengal Electronics Industry Development Corporation Limited (WEBEL)[1]. The primary objective is to reduce the electricity consumption in the project activity building as compared to the electricity consumption in the baseline building (*which has been arrived at in Section B.3*), through certain energy efficiency measures taken in the HVAC system. Both WBSEB and WEBEL fall under Eastern Regional electricity grid. Therefore, reduced electricity consumption by the building "Technopolis" will ultimately result in drawal of lesser amount electricity from West Bengal State Electricity grid which is a part of the Eastern Regional electricity grid. Eastern Regional grid is a thermal power dominated grid. Thus an equivalent amount of GHG emissions in the form of CO_2 released from generation of fossil fuel based thermal power in the regional grid mix will be reduced by the project activity.

Over a crediting period of 10 years, a total electrical energy consumption of 83.725 GWh will be reduced owing to the project activity.

Project's contribution to sustainable development

The contribution of the project activity to sustainable development can be described as follows:

Socio-economic well being: There was a necessity of skilled and semi-skilled jobs during installation of the different energy efficiency equipment in the HVAC system required and so thorough training was imparted to relevant personnel on the commissioned system. The training covered design intent of the system, use of operation and maintenance manual, review of control drawings and schematics, optimizing energy performance, start-up, handling seasonal variations, trouble-shooting, health and safety issues and overview on how the system is environmentally responsive. Such an extensive training helped in building the knowledge and skill base of the employees involved in the construction of the building. The building provides its occupants with a comparatively better quality of working environment with a healthier and safer ambience resulting in better productivity at workplace. The energy efficiency measures taken in the HVAC system have also helped to create business opportunities for technology suppliers, technical consultants not just for "Technopolis" but also for upcoming energy efficient IT buildings in the eastern region of the country.

[1] Refer to http://www.webel-india.com/

Technological well-being: "Technopolis" is energy efficient due to (a) energy efficiency equipments in HVAC system, (b) online monitoring system and control system for optimization of energy performance (c) better roof insulation and (d) glass with glazing of low U factor[2] and solar heat gain co-efficient. These energy efficiency measures have a high replication potential and "Technopolis" will encourage other builders to adopt similar measures.

Environmental well-being: Due to the energy efficiency measures taken in the building, the net electricity consumption in the building is reduced vis-à-vis a similar conventional building which would have been built in absence of the project activity. The project activity would therefore reduce the electricity load on the grid, which will in turn reduce generation of electricity in the grid connected power plants. Reduction in thermal power generation, not only conserves the non-renewable fossil fuels but also reduces the associated emissions of greenhouse gases (GHGs).

A.3. Project participants:

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Name of the Party involved ((host) indicates a host party)	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant(Yes/No)
Government of India	**Phoenix Software Limited (PSL)**	**No**

Phoenix Software Limited (PSL) is owned by Sunsam Properties Private Limited (SPPL), the construction arm of Saraf Group, which is a leading business group, owning and operating large industrial plants as well as undertaking major real estate development projects in India. SPPL has been in the construction field since the last fifteen years and has constructed some of the most prestigious landmark buildings in Kolkata, West Bengal.

[2] Source: http://www.nfrc.org/documents/U-Factor.pdf

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

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

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A.4.1.1. Host Party(ies):

India

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

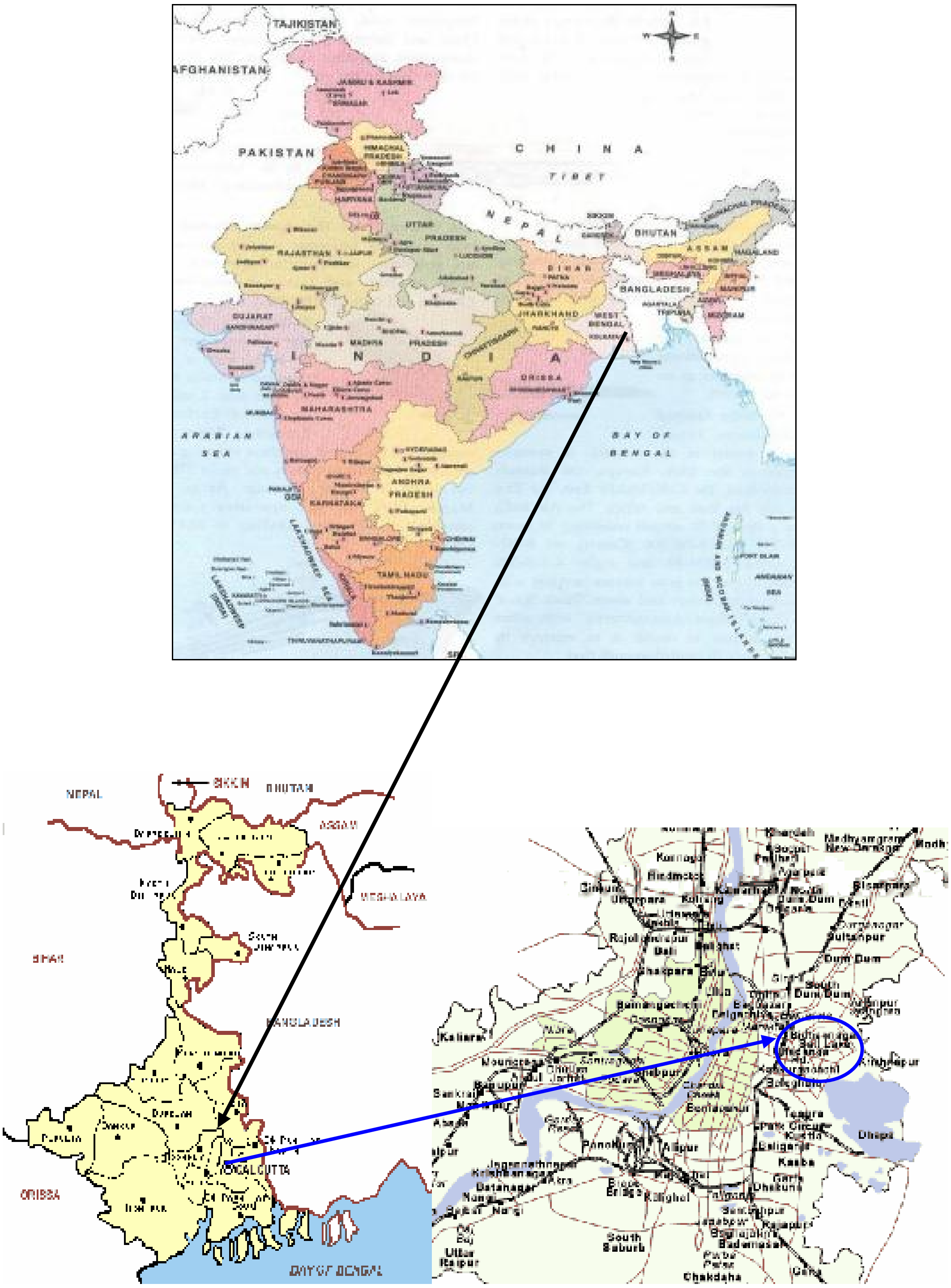
West Bengal

A.4.1.3. City/Town/Community etc:

Kolkata

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

"Technopolis" is in Plot No. BP-4, Sector-V of Salt Lake City, Kolkata, West Bengal. Sector-V in Salt Lake City is the hub of IT Sector in Kolkata and a preferred location of all IT Companies. The project site is within 8 km of Bidhannagar Railway station, the most important railway node-providing interface and transfer facilities of the Suburban Railway System, Circular Railway. The Metro Railway is also located within 9 km of the project activity site. The project site is close to Netaji Subhas International airport at Dumdum. It is well connected with the rest of the city through the Eastern Metropolitan Byepass.


TAJIKISTAN
AFGHANISTAN
PAKISTAN
C H I N A
TIBET
NEPAL
BHUTAN
BANGLADESH
ASSAM
RAJASTHAN
UTTAR PRADESH
GUJARAT
MADHYA PRADESH
I N D I A
JHARKHAND
ORISSA
MAHARASHTRA
ANDHRA PRADESH
KARNATAKA
TAMIL NADU
ARABIAN SEA
BAY OF BENGAL
NEPAL
SIKKIM
BHUTAN
ASSAM
MEGHALAYA
BIHAR
BANGLADESH
ORISSA
CALCUTTA
BAY OF BENGAL
Dum Dum
Kaliara
Dhapa
Sultanpur
Kasba
South Suburb
Chakdaha

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

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Main Category: Type II – Energy efficiency improvement project

Sub Category: "E" - Energy efficiency and fuel switching measures for buildings

As per Appendix B of the UNFCCC-defined simplified modalities and procedures for small-scale CDM project activities, the category "II.E" "comprises any energy efficiency and fuel switching measure implemented at a single building, such as a commercial, institutional or residential building, or group of similar buildings, such as a school, district or university. Examples include technical energy efficiency measures (such as efficient appliances, better insulation and optimal arrangement of equipment) and fuel switching measures (such as switching from oil to gas). The technologies may replace existing equipment or be installed in new facilities".

The project activity consists of energy efficiency measures installed in "Technopolis". The project activity would reduce energy consumption on the demand side. The net electrical energy consumption reduction achievable will be around 8.37 GWh /annum.

Evidently, the project qualifies as a small scale one under Type II.E.

Technology of the project activity

In "Technopolis", the thermal resistance of the building envelope will be increased, thereby reducing the unwanted heat loss and heat gain from the outside. This will in turn reduce the energy required for air conditioning in the building. Insulation will also improve thermal comfort in addition to reducing air conditioning equipment sizes. Apart from the building envelope, the central plant will also use efficient chiller type, with proper sizing contributing to optimum energy utilization. The major parameters which have resulted in the reduced electricity consumption in the HVAC system of "Technopolis", are detailed below:

[A] Exposure of glass wall area

(1) The glazing used in the building is of high performance double glazed panels coated with reflective low "e"-glass panes and having low U-value[3] and solar heat gain co-efficient. High quality imported glass with low shading co-efficient and high visible light transmittance has been used in order to reduce solar gains and to enhance available daylight in the space without compromising on energy efficiency.

(2) Since glass is a poor insulator, the space between the spandril and the sill areas have also been insulated with mineral fibre wool to further reduce heat influx in to the building.

[B] Roof insulation

U-value of the roof has been kept low with R-15 extruded polystyrene insulation. Terrace gardening has been done to provide additional insulation for the roof. The evapo-transpiration effect due to the terrace garden will also contribute to keeping the building cool during summer season.

[C] Air Handling Unit

Regular office spaces have been divided into zones based on occupancy pattern and ease of air distribution. Each of these zones have been provided with an individual AHU comprising centrifugal supply and return air fans, cooling coil section, steel double sloping drain pan and filter section. Each of the fourteen floors of "Technopolis" have four AHUs and the ground floor has seven AHUs. Each AHU is provided with a two way valve control, sensing cooling coil leaving air temperature, filter monitoring switch, duct smoke detector unit to trip blower in case of smoke detection. Each AHU is provided with a VFD driven supply air blower and each AHU room has a Heat Recovery Wheel (HRW) with a supply air fan and return air fan. The highly efficient HRW enables further reduction in the heat load to be handled by the AHU. The volume of fresh air entering into the building, is modulated based on CO_2 sensors, located within return air

[3] Glass industry measures the energy efficiency of their products in terms of thermal transmission, or U-factor. U-factor measures the rate of heat transfer through a product. Therefore, the lower the U-factor, the lower the amount of heat loss, and the better a product is at insulating a building. Apart from conductivity, U-factor also is affected by the airflow around the window and the emissivity (e) of the glass. The lower the conductivity and emissivity of the glass, the lower the rate of heat loss and the lower the U-factor.

duct of AHU serving each occupied zone. Both the indoor and outdoor CO_2 levels are continuously logged through integrated building management system (IBMS), Based on the CO_2 differential the quantity of fresh air brought in to the building is varied using the VFDs.

A VFD is installed to the rotor of the electric drives to operate them at variable speed. Since the rotor can operate at any speed below its maximum capacity, the output of the motor can be made to vary by controlling the rotor speed by a VFD installation. A variable frequency drive can control two main elements of a 3-phase induction motor: speed and torque. This is adjusted by changing the frequency applied to the motor. If the required output of the rotor is lower than the present output capacity, the frequency of the rotor may be regulated below full operational capacity by the variable frequency drive. Therefore under low occupancy scenarios, the VFDs would enable the motor to operate at lower operational capacity, which would reduce the quantity of fresh air required to be handled by the HVAC system, thereby reducing the heat load on the HVAC System. With reduction in frequency of the rotor, the power input to the motor reduces proportionately.

Moreover supply air fan and return air fan of each HRW is installed with VFDs, thereby varying the quantity of electricity consumed by the fans in accordance with the variation in air handled by AHU.

Chillers

To meet the load demand, two 650 TR water-cooled centrifugal chillers with COP of 6.1 are installed & a 300 TR water-cooled screw chiller with COP of 5.5, has been kept as a standby. Water-cooled chillers are more efficient than air cooled ones in air-conditioning of large buildings. Each water cooled chiller has two condenser pumps, one working and the other one as standby.

Pumping Systems

Chilled water is pumped with a primary-secondary pumping arrangement. Each chiller has two primary pumps, one working and the other one as standby. There are three secondary pumps. The primary loop pump circulates chilled water through the chillers, and the secondary pumps distribute chilled water to the building. VFDs are installed both in the primary and secondary chilled water loops. VFD in the primary pump is used to reduce the speed of the pump while the balancing valve is kept fully open. The electricity consumption of the pumps in the primary chilled water loop, can thus be varied. VFDs in the pumps of secondary chilled water loop accommodate the variations in the chilled water demand depending on the quantity of air being handled by the AHUs of the building. The chilled water system is designed for 1.9 GPM flow per TR.

Cooling Towers

There are two 1700 TR cooling towers in the HVAC system of "Technopolis", for cooling the water used as cooling medium in the HVAC system of the building.

With these measures in place, the HVAC system will operate at high energy efficiency and will have tremendous flexibility to run efficiently under part load conditions. Out of the many functions to be performed by the IBMS, one major function will be energy management through optimization of all connected electrical and mechanical plants. BMS comprises the following HVAC automation services – chiller plant automation, AHU monitoring and control, stairwell pressurization and control, common area smoke extraction fan control, smoke extract fans of individual fans, VFDs, CO_2 sensor monitoring and modulating damper control, car park area CO sensor monitoring and ventilation fan control.

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

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The crediting period for the project activity will start after the date of registration from April 2007.

Operating Years	CO_2 Emission Reductions (tonnes of CO_2)
August 2007- July 2008	8724.15
August 2008- July 2009	8724.15
August 2009- July 2010	8724.15
August 2010- July 2011	8724.15
August 2011- July 2012	8724.15
August 2012- July 2013	8724.15
August 2013- July 2014	8724.15
August 2014- July 2015	8724.15
August 2015- July 2016	8724.15
August 2016- July 2017	8724.15
Total estimated reductions (tonnes of CO_2 e)	**87241.5**
Total number of crediting years	10

Operating Years	CO_2 Emission Reductions (tonnes of CO_2)
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	8724.15

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

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No public funding from parties included in Annex-I is available to the project activity.

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

As mentioned in Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities, a small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small scale activity at the closest point.

PSL has not implemented any other project activity, which falls under Category- II.E of “Appendix B of the simplified modalities and procedures for small-scale CDM project activities” and deals with the same technology/measure. No such project activity, proposed by PSL with the same project category and technology/ measure and whose boundary is within 1 km of the project boundary of the small-scale project activity under consideration at its closest point, is registered or in the advanced stage of registration with UNFCCC in the last two years.

With the above explanation, it can be concluded that the small-scale project activity of PSL is not a debundled component of a large project activity. Therefore the project activity under consideration is eligible to make use of “Appendix B of the simplified modalities and procedures for small-scale CDM project activities” for the determination of emission reductions resulting from the 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:

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Title: ***Energy efficiency and fuel switching measures for buildings***

Reference: Type II (Energy Efficiency Improvement Projects) E (***Energy efficiency and fuel switching measures for buildings***) **-** Appendix B of the simplified modalities and procedures for small-scale CDM project activities – Indicative Simplified Baseline and Monitoring Methodologies for selected small-scale CDM project activity categories, **(Version 08, December 23, 2006)**

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

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As per the provisions of Paragraph 12 of Simplified Modalities and Procedures for Small Scale CDM Project Activities [FCCC/CP/2002/7/Add.3, English, Page 21], "to use simplified modalities and procedures for small-scale CDM project activities, a proposed project activity shall[4]":

1. Meet the eligibility criteria for small-scale CDM project activities set out in paragraph 28 of Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its second session, held at Nairobi from 6 to 17 November 2006 [FCCC/KP/CMP/2006/10/Add.1, English, Page 08][5] ; Point ii. [Energy efficiency improvement project activities which reduce energy consumption, on the supply

[4] *Extract of paragraph 12 of Simplified Modalities and Procedures for Small Scale CDM Project Activities*

[5] *In accordance with decision 17/CP.7 (contained in document FCCC/CP/2001/13/Add.2), paragraph 6 (c), simplified modalities and procedures have been developed for the following types of small-scale CDM project actives the revised definitions of which is provided in paragraph 28 of decision -/CMP.2:*
Type I: Renewable energy project activities with a maximum output capacity equivalent to up to 15 megawatts (or an appropriate equivalent);
Type II: Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, limited to those with a maximum output of 60 GWh per year (or an appropriate equivalent);
Type III: Other project activities limited to those that result in emission reductions of less than or equal to 60 kt CO2 equivalent annually;

and/or demand side, limited to those with a maximum output of 60 GWh per year (or an appropriate equivalent)]

The project activity includes energy efficiency measures taken in the HVAC system which will result in reduced electricity consumption than that in the baseline scenario (baseline scenario has been elucidated in Section B.3). The project activity will therefore lower electricity consumption and subsequent electricity withdrawal from the grid and its equivalent Carbon-dioxide emissions by thermal power generating sources of the grid.

The net reduction in electrical energy consumption on the demand side achievable in "Technopolis" as a result of the project activity, will be around 8.37 GWh /annum, which is lower than the limit of 60 gigawatt hours (electrical) per year of the small scale methodology AMS II.E of '***Energy efficiency and fuel switching measures for buildings'.*** The project activity therefore meets the eligibility criteria for Type II under small-scale CDM project activities.

2. Conform to one of the project categories in Appendix B to this annex;

The project activity conforms to "Category II.E" project category in Appendix B. The justification of the same has been provided in Section A.4.2

3. Not be a debundled component of a larger project activity, as determined through Appendix C to this annex.

The project activity is not a debundled component of a larger project activity as determined through Appendix C of Simplified Modalities and Procedures for Small Scale CDM Project Activities [FCCC/CP/2002/7/Add.3, English, Page 21]. The justification of the same has been provided in Section A.4.5

Therefore the project activity meets the 'Small Scale CDM Project Activities' applicability criteria.

Further in accordance with Paragraph 28 of the simplified modalities and procedures for small-scale CDM project activities, a simplified baseline and monitoring methodology listed in this appendix (Appendix B) may be used for a small-scale CDM project activity if project participants are able to demonstrate to a designated operational entity that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in Attachment A of this Appendix (B). The project activity faces investment barriers listed in Attachment A of Appendix B in order to reduce CO_2 emissions as required by the Paragraph 28 of the simplified modalities and procedures for small-scale CDM project activities. The details of the barriers are enlisted in Section B3.

Hence, the use of simplified baseline methodology for the project category 'Category II.E (point 2)' specified in Appendix B is justified for determination of the baseline emission of the project activity.

B.3. Description of the project boundary:

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As per paragraph 2 under "Type II.E: Energy efficiency and fuel switching measures for buildings*"* in Appendix B of the Simplified M&P for small scale CDM project activities (Sectoral Scope: 3, Version 08: December 23, 2006), "the project boundary is the physical, geographical site of the building(s)". Therefore for the project activity under consideration, the project boundary will include 'Technopolis' building where the energy efficiency measures have been taken and which result in consumption of lesser amount of electricity consumption by the building. However, reduced electricity consumption by "Technopolis" will ultimately result in drawal of lesser amount electricity from West Bengal State Electricity grid which is a part of the Eastern Regional electricity grid. For computation of emission reductions resulting from the project activity, Eastern Regional electricity grid and all the power plants catering to the grid have been considered in order to arrive at the emission factor corresponding to power generation in the grid. However, the emission factor corresponding to power generation in the grid, has been taken to be constant for the computation of emission reduction for the entire crediting period.

B.4. Description of baseline and its development:

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The baseline category and methodology applicable for the project activity has already been justified in Section B.2. As per paragraphs 3 and 4 under Category II.E in Appendix B of the Simplified M&P for small scale CDM project activities (Sectoral Scope: 3, Version 08: December 23, 2006), '***the energy baseline consists of the energy use*** *of the existing equipment that is replaced in the case of retrofit measures and* ***of the facility that would otherwise be built in the case of a new facility****. Each energy form in the emission baseline is multiplied by an emission coefficient. For the electricity displaced, the emission coefficient is calculated in accordance with provisions under category I.D. For fossil fuels, the IPCC default values for emission coefficients may be used.*'

Energy Baseline

The energy baseline for the project activity under consideration is the electrical energy use of the HVAC system of the baseline building (Please refer to Section B.3 for definition of baseline building). The project activity reduces electricity consumption of the HVAC system of "Technopolis" in comparison to the baseline scenario. However, there is an avenue kept for electricity generation by diesel generator (DG) set and consumption of the same electricity in "Technopolis" in case of exigencies like load-shedding by the grid. Emission reduction will be based on the reduced electricity drawal from the grid and also based on the reduced load on the DG set that would be used in case of exigencies, due to the reduced electricity consumption in the HVAC system, in the project scenario compared to the baseline scenario.

Emission factor for electricity drawn from the grid

Since the reduced electricity drawal from the Eastern Regional Electricity grid due to efficient HVAC system, is the element that is likely to affect both the operating margin in the short run and the build margin in the long run, electricity baselines should reflect a combination of these effects. Therefore an ideal baseline approach is envisaged as the one that combines both Operating and Build Margin as prescribed in first alternative given in paragraph 9 under Category I. D of the UNFCCC M&P for small scale projects.

Hence, reduction in grid based electricity consumption by the HVAC system of "Technopolis", will be multiplied by the emission co-efficient of Eastern Regional Electricity grid (in kg CO_2/ kWh) in order to arrive at the emission reductions from reduced grid based electricity consumption. In case of the project activity, a combined margin (CM) emission factor, consisting of the combination of operating margin emission factor and build margin emission factor, calculated according to the procedures prescribed in the approved methodology ACM0002 and publicly available in the official website of CEA, has been used for arriving at the baseline. The simple operating margin emission factors from 2002 to 2005 (inclusive of imports) and the build margin emission factor (not adjusted for imports) for the Eastern Regional Electricity grid, as per CEA published data, has been provided below.

	2002-03	2003-04	2004-05	
East	1.17	1.20	1.17	Using approach (c) on p. 4 of ACM0002 / Ver 06

Average simple operating margin emission factor for the Eastern Regional electricity grid = (1.17 + 1.20 + 1.17)/3 t CO_2/MWh= 1.18 t CO_2/MWh.

Build Margin (tCO_2/MWh)	
	2004-05
East	0.9

Calculation of combined margin

As per ACM 0002 (Version 06, Sectoral Scope: 01, 19 May 2006), the combined margin emission factor should be calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EFy = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$

where, the weights are w_{OM}=w_{BM}= 0.5.

The most recent 3-years (2002-2003, 2003-2004 & 2004-2005) average of the Simple OM and the BM of the base year i.e. 2004-2005 are considered. This is presented in the table below.

Table B-11: Data used for Baseline Emission Factor

Parameters	Values (ton of CO_2/MWh)	Remarks
OM, $EF_{OM,y}$	1.18	Average of most recent 3-years (2002-2003, 2003-2004 & 2004-2005) values
BM, $EF_{BM,y}$ (ton of CO_2/MU)	0.9	Value of the base year i.e. 2004-2005
Baseline Emission Factor, $EF_{GRID,y}$	**1.042**	Calculated

Emission factor for electricity drawn from the DG set

Emission reductions corresponding to reduced DG set based electricity consumption by the HVAC system, will be obtained by multiplying reduction in DG set based electricity consumption of the HVAC system with the emission factor for electricity generated by the DG set. For the project activity under consideration, the emission factor (EF_{DG}) for the electricity generated by DG set, for both the baseline and project scenarios have been taken to be equal to the 0.8 kg CO_2 e/kWh, a value provided in table I.D.1 in AMS. I.D in Appendix B of the Simplified M&P for small scale CDM project activities (Version 10, Sectoral Scope: 1, 23 December 2006). In considering the value, it has been assumed that the DG sets of CPP is a mini grid with temporary service (4-6 hours a day), operating at 50% load factor.

Key information and data used to determine the baseline scenario are as provided in the following table - Table B.3:

Sl. No.	Variable	Parameters	Data sources
01	$E_{chiller,b}$	Electricity that would have been consumed by the chiller plant (air cooled chiller of COP 3 without HRWs in the AHUs) of "Technopolis" in the baseline scenario (in MWh)	Energy simulation based on the design parameters for the baseline building
02	$E_{pumps,b}$	Electricity that would have been consumed by the chilled water pumping system (without VFDs in the pumps of the primary chilled water loop) of "Technopolis" in the baseline scenario (in MWh)	Energy simulation based on the design parameters for the baseline building
03	$E_{AHUs,b}$	Electricity that would have been consumed by the AHUs (without VFDs on the fans) of "Technopolis" in the baseline scenario (in MWh)	Energy simulation based on the design parameters for the baseline building
04	$T_{op,HVAC,b}$	Operating hours of the HVAC system of "Technopolis" in the baseline scenario	Expected occupancy pattern report for "Technopolis"

05	$EF_{GRID,}$	Combined margin emission factor (in tCO_2/kWh) of the Eastern Regional Electricity grid (calculated ex-ante and kept constant for the entire crediting period)	CEA published CDM – Carbon dioxide baseline database[6]
06	EF_{DG}	CO_2 emission factor (in tCO_2/kWh) for electricity generated by the DG set in "Technopolis"	Table I.D.1 in AMS. I.D in Appendix B of the Simplified M&P for small scale CDM project activities (Version 10, Sectoral Scope: 1, 23 December 2006).

[6] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

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:

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Before project activity implementation, PSL was aware that the project activity would entail high investment cost which would be over and above that required to meet the standards of an IT building, with similar size. This additional expenditure would not be recovered through higher rent rates for the building. In order to attain occupancy in a competitive market, PSL knew that they would need to meet the prevailing market rates, introduced by other IT buildings.

PSL assessed plausible alternatives that were available other than the energy efficiency measures taken under the project activity. An assessment of all these alternatives is required to be carried out with respect to the barriers associated with their implementation in order to arrive at the baseline scenario i.e. the most likely future scenario in absence of the project activity. The GHG performance of the project activity and its associated emission reductions will be evaluated with respect to the baseline scenario.

Selection of Baseline Scenario

Table B.1: Alternatives for the different energy efficiency measures taken in the HVAC system of Technopolis:

Parameters affecting the HVAC system	Alternatives	Barriers	Baseline Option
A. Exterior wall construction	Alternative A-1: Mass wall of U-factor 1.0 Btu/hr. ft^2. ^0F	Such a wall construction would entail low capital investment.	Alternative A-2 would not be a credible and realistic alternative option for PSL to implement because of the high investment involved and can be excluded from further consideration as a
	Alternative A-2: 9" thick brick wall with plaster inside and outside and effective U value would be 0.32 Btu/hr. ft^2. ^0F	Such a wall construction would entail comparatively higher capital investment.	

			possible baseline scenario. Instead, alternative A-1 which is a lower investment option, can be concluded to be the viable option available to PSL in absence of the project activity. Therefore this alternative option is the baseline option for the exterior wall construction.
B. Exposure of glass wall area	Alternative B-1: The glasses used would be plain glass. The U-value of the fenestration would be 1.0 Btu/hr.ft^2 .^{0}F on the north and non-north sides. The glass would have shading co-efficient of 0.656 on all sides and 70% visible light transmittance on all sides.	Such a quality of glass is easily available in India. The total cost of glazing for the building would be around INR 204 lac	Alternative B-2 would not be a credible and realistic alternative option for PSL to implement because of the high investment involved and can be excluded from further consideration as a possible baseline scenario. Instead, alternative B-1 which is a lower investment option, can be concluded to be the viable option available to PSL in
	Alternative B-2: The glazing used in the building would be of high performance double glazed panels coated with reflective low "e"-glass panes and having low U-value and solar heat gain co-efficient. The U-value of the fenestration would be	The kind of glass that has been used for glazing of "Technopolis" is not yet locally manufactured by Indian glass industry. So the project proponent	

	0.27 Btu/hr.ft^2 .^{0}F on the north and 0.41 Btu/hr.ft^2 .^{0}F on the non-north sides. High quality imported glass (with shading co-efficient of 0.15 on the north side and 0.12 on the non-north sides), would be used. The fenestration would have a visible light transmittance of 23% on the north and 6% on the non-north sides. These are the measures taken in the fenestration of "Technopolis", without consideration of CDM benefits.	had to resort to Emirates Glass of United Arab Emirates for an in-depth review of the EMICOOL Range of high performance glass. The cost of glazing for "Technopolis" was around INR 243 lac.	absence of the project activity. Therefore this alternative option is the baseline option for the exposure of glass wall area.
C. Roof insulation	Alternative C-1: Insulation would be entirely above deck, with R=15 and roof reflectivity of 0.30	Capital cost as well as operating cost is low.	The alternative C-2 would not be a credible and realistic alternative option for PSL to implement due to the higher capital as well as operating cost. It can be excluded from further consideration as a possible baseline scenario. Instead, alternative C-1 entailing lower capital as well as operating cost, can be concluded to be the viable option available to PSL in absence of the
	Alternative C-2: Insulation would be entirely above deck, with R=15 extruded polystyrene, terrace gardening and roof reflectivity of 0.30. These are the measures taken in the roof insulation of "Technopolis", without consideration of CDM benefits.	Capital cost is high. Moreover maintenance of the terrace garden is necessary, thereby requiring additional manpower and increasing the operating cost.	

			project activity. Therefore this alternative option is the baseline option for roof insulation.
D. Air Handling Unit (AHU)	Alternative D-1: The air handling system would be a constant air volume system with 2" of static fan and reset by warmest zone, without any economizer and heat recovery wheel.	Capital cost of implementation is low since there is no HRW at all. There is no need for extensive metering for proper monitoring and control. Operation and maintenance cost is also low.	The alternative D-2 would not be a credible and realistic alternative option for PSL to implement due to the higher costs involved in investment, operation and maintenance, requirement of extensive metering. Therefore this alternative can be excluded from further consideration as a possible baseline scenario. Instead, alternative D-1 which is a much cheaper option, can be concluded to be the viable option available to PSL in absence of the project activity. Therefore this alternative option is the baseline option.
	Alternative D-2: The air handling system would be a variable air volume system with 2" of static fan and reset by warmest zone, with economizer and heat recovery wheel of 65% efficiency. These are the measures taken in the air handling units of "Technopolis", without consideration of CDM benefits.	Capital cost of implementation is high since there are 50 HRWs installed in the HVAC system. The supply and return air fans in the HRWs are provided with VFDs. Extensive metering has been done for proper monitoring of the energy consumption reduction and control. Operation and maintenance cost is also much higher.	

E. Chillers	Alternative E-1: Air cooled chillers with a full load efficiency of 1.17 kW/TR (a COP of 3.0 at ARI conditions) and primary secondary pumping of chilled water with VFDs on the primary pumps and fixed drives on the secondary pumps.	Capital cost of implementation is low since low efficiency air cooled chiller is used and VFDs are used in limited areas. There is no need for extensive metering for proper monitoring and control. Operation and maintenance cost is also low.	The alternative E-2 would not be a credible and realistic alternative option for PSL to implement without consideration of CDM benefits and can be excluded from further consideration as a possible baseline scenario. Instead, alternative E-1 which is a much cheaper option, can be concluded to be the viable option available to PSL in absence of the project activity. Therefore this alternative option is the baseline option for the AHU.
	Alternative E-2: Water cooled chillers with a full load efficiency of 0.576 kW/TR (a COP of 6.1 at ARI conditions); primary secondary pumping of chilled water with VFDs on the both primary and secondary pumps and VFDs on cooling towers as well. These are the measures taken in the chiller plant of "Technopolis", without consideration of CDM benefits.	Capital cost of implementation is much higher since water cooled chillers have been used. For obtaining the proper quality of water, PSL had to set up a water treatment plant, thereby adding to their capital expenditure just for the energy efficiency of the HVAC system Moreover VFDs have been installed in the pumps of the primary chilled water loop as well. Extensive metering for proper monitoring	

		and control has been done to account for the energy conservation. Operation and maintenance cost is also much higher.	

Conclusion: As elucidated above, net effect of reduction in electricity consumption of "Technopolis" building, is the cumulative effect of each and every energy efficiency measure. Further, PSL also had to keep adequate stock of certain expensive spare parts of the HVAC system, thereby incurring additional expense. The common practice assessment further substantiated the fact that the project activity is not a baseline scenario. Technopolis is among the first few projects of its kind in the country. Moreoever, the financial benefits of the energy savings attained as a result of the project activity will be reaped by the occupants of the building, although the additional investment for the project activity would have to be entirely borne by "Technopolis".

However with objective of contribution to GHG abatement and thereby availing the credits from GHG emission reduction, the management of PSL has gone ahead with the project option. The corporate decision to invest

- in overcoming the barriers encountered in the project activity implementation
- in the project activity

has been guided by the anthropogenic greenhouse gas emission reductions the project activity would result in and the associated carbon financing the project activity would receive through sale of Certified Emission Reductions under the Clean Development Mechanism .

Therefore, the project activity is not a plausible baseline option. The baseline scenario would be a combination of the baseline options for each of the parameters in the HVAC system, that are conducive to energy conservation in "Technopolis", i.e. the baseline option is a combination of alternatives A-1, B-1, C-1, D-1 and E-1 which together can be concluded to form the baseline building.

Based on the baseline methodology, it is calculated that (see section E for the calculation) the project activity will avoid 87241.5 tonnes of CO_2 equivalent emissions in a 10 year credit period, by drawing lesser amount of electricity generated in the Eastern Regional electricity grid. Hence, the project activity is not a baseline scenario and without the project activity there will be generation of additional quantum of electricity in the grid thereby leading to GHG emissions as per the power generation sources of the grid mix.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Calculation of electricity that would be consumed by the HVAC system in the baseline scenario

$$E_{HVAC,b} = E_{chiller,b} + E_{pumps,b} + E_{AHUs,b}$$

Where,

$E_{HVAC,b}$ – Electricity that would have been consumed by the HVAC system of "Technopolis" in the baseline scenario (in MWh)

$E_{chiller,\ b}$ – Electricity that would have been consumed by the chiller plant (air cooled chiller of COP 3 without HRWs in the AHUs) of "Technopolis" in the baseline scenario (in MWh)

$E_{pumps,\ b}$ – Electricity that would have been consumed by the chilled water pumping system (without VFDs in the pumps of the primary chilled water loop) of "Technopolis" in the baseline scenario (in MWh)

$E_{AHUs,\ b}$ – Electricity that would have been consumed by the AHUs (without VFDs on fans) of "Technopolis" in the baseline scenario (in MWh)

$$E_{HVAC,b,y} = \frac{E_{HVAC,b}}{T_{op,HVAC,b}} \times T_{op,HVAC,y}$$

Where,

$E_{HVAC,b,y}$ – Electricity that would have been consumed by the HVAC system of "Technopolis" in the baseline scenario corresponding to the operating hours of the chiller plant in the year y of the project scenario (in MWh)

$T_{op,HVAC,b}$ – Operating hours of the HVAC system of "Technopolis" in the baseline scenario

$T_{op,HVAC,y}$ – Operating hours of the HVAC system of "Technopolis" in a year y in the project activity scenario

Calculation of electricity consumption in the project activity scenario

$$E_{HVAC,p,y} = E_{chiller,y} + E_{CT,y} + E_{pumps,y} + E_{AHUs,y}$$

Where,

$E_{HVAC,\,p,\,y}$ – Electricity that will be consumed by the HVAC system of "Technopolis" in the year y in the project activity scenario(in MWh)

$E_{chiller,\,y}$ – Electricity that will be consumed by the chiller plant (water cooled screw chillers of COP 6.1) of "Technopolis" in the project activity scenario (in MWh)

$E_{CT,\,y}$ – Electricity that will be consumed by the cooling tower of "Technopolis" in the year y in the project activity scenario (in MWh)

$E_{pumps,\,y}$ – Electricity that will be consumed by the chilled water pumping system (with VFDs in the pumps of the primary and secondary chilled water loops) of "Technopolis" in the year y in the project activity scenario (in MWh)

$E_{AHUs,\,y}$ – Electricity that will be consumed by the AHUs (with VFDs on fans and HRWs) of "Technopolis" in the year y in the project activity scenario (in MWh)

Reduction in electricity consumption with respect to the baseline scenario

$$\mathbf{E_{r,\,y} = E_{HVAC,b,\,y} - E_{HVAC,\,p,\,y}}$$

Where,

$\mathbf{E_{r,\,y}}$ **–** Reduction in electricity consumption in the year y in the project activity scenario with respect to the baseline scenario due to the energy efficiency measure taken in "Technopolis" building (in MWh)

Calculation of reduction in drawal of electricity from the grid with respect to the baseline scenario

$$E_{r,GRID,y} = \frac{E_{GRID,y}}{E_{GRID,y} + E_{DG,y}} \times E_{r,y}$$

Where,

$E_{r,\,GRID,\,y}$ - Reduced electricity drawal (wrt the baseline scenario) from the grid due to the energy efficiency measures taken in "Technopolis" (in MWh)

$E_{GRID,y}$ –Electricity drawn from the Eastern Regional Electricity grid by "Technopolis" in the year y in the project activity scenario (in MWh)

$E_{DG,y}$ - Electricity generated by Diesel Generator (DG) set of "Technopolis" in the year y (in MWh)

Calculation of reduction in drawal of electricity from the DG with respect to the baseline scenario

$$E_{r,DG,y} = \frac{E_{DG,y}}{E_{GRID,y} + E_{DG,y}} \times E_{r,y}$$

Where,

$E_{r,DG,y}$ - Reduced DG based electricity consumption in the HVAC system in the year y in the project activity scenario (in MWh).

Calculation of baseline emissions (BE_y)

$$BE_y = E_{r,GRID,y} \times EF_{GRID} + E_{r,DG,y} \times EF_{DG}$$

Where,

EF_{GRID} – Emission factor for electricity drawn from the Eastern Regional Electricity grid (in t CO_2/MWh)

EF_{DG} – Emission factor for electricity drawn from the DG set (in t CO_2/MWh)

Project activity emissions

For the project activity under consideration, the emission reductions will be computed on the basis of the net amount of electrical energy consumption reduction wrt the baseline scenario. Therefore, there will be no project emissions arising out of additional electricity consumption under the project activity. So, project emissions (PE_y) = 0

Leakage

As per paragraph 5 of Appendix B of Category II.D (Version 8, 23rd December 2006, Sectoral Scope: 4) small scale methodologies, "*if the energy efficiency technology is equipment transferred from another activity or if the existing equipment is transferred to another activity, leakage is to be considered*". For the project activity under consideration, the energy efficient technology includes installation of electrical equipments, fenestration and insulations in a new building. All the energy efficient technologies are new installations and not diverted from already existing utilization areas. Therefore, there is no leakage that needs to be considered for the project activity under consideration and leakage (L_y) = 0.

Emission reductions (ER_y) due to project activity = $BE_y - PE_y - L_y = BE_y - 0 = BE_y$

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

(Copy this table for each data and parameter)

Data / Parameter:	$\mathbf{E_{chiller,b}}$
Data unit:	MWh
Description:	Electricity that would have been consumed by the chiller plant (air cooled chiller of COP 3 without HRWs in the AHUs) of "Technopolis" in the baseline scenario
Source of data used:	Energy simulation based on the design parameters for the baseline building
Value applied:	8084.944
Justification of the choice of data or description of measurement methods and procedures actually applied :	An energy simulation has been done for the chiller plant of the baseline building which is a conventional building with the same occupancy-type in the same region as "Technopolis". The specifications of the chiller plant for the baseline building have been provided in Table A.1 in Section A.1
Any comment:	

Data / Parameter:	$\mathbf{E_{pumps,b}}$
Data unit:	MWh
Description:	Electricity that would have been consumed by the chilled water pumping system (without VFDs in the pumps of the primary chilled water loop) of "Technopolis" in the baseline scenario
Source of data used:	Energy simulation based on the design parameters for the baseline building
Value applied:	549.125
Justification of the choice of data or description of measurement methods and procedures actually applied :	An energy simulation has been done for the chiller plant of the baseline building which is a conventional building with the same occupancy-type in the same region as "Technopolis". The details of the measures in the chilled water pumping system for the baseline building have been provided in Table A.1 in Section A.1
Any comment:	

Data / Parameter:	$E_{AHUs,b}$
Data unit:	MWh
Description:	Electricity that would have been consumed by the AHUs (without VFDs on the fans) of "Technopolis" in the baseline scenario
Source of data used:	Energy simulation based on the design parameters for the baseline building
Value applied:	3474.910
Justification of the choice of data or description of measurement methods and procedures actually applied :	An energy simulation has been done for the AHUs of the baseline building which is a conventional building with the same occupancy-type in the same region as "Technopolis". The details of the measures in the AHUs for the baseline building have been provided in Table A.1 in Section A.1
Any comment:	

Data / Parameter:	$T_{op,HVAC,b}$
Data unit:	hours
Description:	Operating hours of the HVAC system of "Technopolis" in the baseline scenario
Source of data used:	Expected occupancy pattern report for "Technopolis"
Value applied:	16
Justification of the choice of data or description of measurement methods and procedures actually applied :	"Technopolis" is an IT space. It is meant for IT and IT enabled services which entail average occupancy time of 16 hours/day per head in the offices.
Any comment:	

Data / Parameter:	EF_{GRID}
Data unit:	t CO_2/MWh
Description:	Emission factor for electricity imported from the West Bengal State Electricity grid which is under the North-Eastern Regional electricity grid
Source of data used:	CEA published CDM – Carbon dioxide baseline database[7]
Value applied:	Combined margin emission factor (in tCO_2/kWh) of the Eastern Regional Electricity grid:- 1.042
Justification of the choice of data or description of	Calculated ex-ante from the following data on simple margin and build margin emission factors for the Eastern Regional electricity grid and kept constant for

[7] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

<table>
<tr><td>measurement methods and procedures actually applied :</td><td>the entire crediting period.

<table>
<tr><td colspan="4">Simple Operating Margin (tCO2/MWh) (incl. Imports)</td></tr>
<tr><td></td><td>2002-03</td><td>2003-04</td><td>2004-05</td></tr>
<tr><td>East</td><td>1.17</td><td>1.20</td><td>1.17</td></tr>
<tr><td colspan="4">Build Margin (tCO2/MWh) (not adjusted for imports)</td></tr>
<tr><td></td><td>2004-05</td><td></td><td></td></tr>
<tr><td>East</td><td>0.90</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Data / Parameter:	**EF_{DG}**
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor for the DG set of CPP
Source of data used:	Table I.D.1 in AMS. I.D in Appendix B of the Simplified M&P for small scale CDM project activities (Version 10, Sectoral Scope: 1, 23 December 2006)
Value applied:	0.8
Justification of the choice of data or description of measurement methods and procedures actually applied :	For the project activity under consideration, EF_{DG} is taken to be equal to the 0.8 kg CO_2 e/kWh, a value provided in table I.D.1 in AMS. I.D in Appendix B of the Simplified M&P for small scale CDM project activities (Version 10, Sectoral Scope: 1, 23 December 2006). In considering the value, it has been assumed that the DG sets of CPP is a mini grid with temporary service (4-6 hours a day), operating at 50% load factor.
Any comment:	EF_{DG} has been considered as the ex-ante emission factor and will be kept constant for the entire crediting period

B.6.3 Ex-ante calculation of emission reductions:

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The following table elucidates how the project activity reduces the emissions corresponding to the reduced electricity consumption with respect to the baseline scenario:

Alternative	Electrical End-use Totals (kWh)					
	Electrical Plug Loads	Chiller Plant	Cooling Tower	Chilled Water Circulation Pumps	AHUs	Total electricity consumption of the HVAC system per annum
Baseline Building - Air Cooled (COP 3.0)	4,120,022	8,084,944	0	549,125	3,474,910	16,229,001
Technopolis building as designed	4,120,022	2,646,941	396,286	99,942	593,304	7,856,495

Reduction in electricity consumption compared to baseline building (MWh/Year)	8,373
Emission Factor for electricity drawn from Eastern Regional Electricity Grid	1.042
Emission Reductions due to energy efficiency measures taken in the HVAC system of "Technopolis" (in t CO_2/annum)	**8,724.15**

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

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Year	Estimation of project activity emissions (tCO_2 e)	Estimation of baseline emissions (tCO_2 e)	Estimation of leakage (tCO_2 e)	Estimation of overall emission reductions (tCO_2 e)
2007 – 2008	0	8724.15	0	8724.15
2008 – 2009	0	8724.15	0	8724.15
2009 – 2010	0	8724.15	0	8724.15
2010 – 2011	0	8724.15	0	8724.15
2011 – 2012	0	8724.15	0	8724.15
2012 – 2013	0	8724.15	0	8724.15
2013 – 2014	0	8724.15	0	8724.15
2014 – 2015	0	8724.15	0	8724.15
2015 – 2016	0	8724.15	0	8724.15
2016 – 2017	0	8724.15	0	8724.15
Total (tonnes of CO_2 e)	**0**	**87241.5**	**0**	**87241.5**

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

Title: Monitoring Methodology for – ***Energy efficiency and fuel switching measures for buildings***

Reference: Paragraph 7 of Category II.E as provided in Appendix B of the Indicative Simplified Baseline and Monitoring Methodologies for selected small-scale CDM project activity categories.

As per the provisions of Simplified Modalities and Procedures for Small Scale CDM Project Activities [FCCC/CP/2002/7/Add.3, English, Page 21] the "Project participants may use the **simplified baseline and monitoring methodologies specified in appendix B** for their project category" if they meet the applicability criteria of Small scale CDM project activity. Since the project activity is a small-scale project of a new energy efficient facility classifiable under II.E category the monitoring methodology and plan has been developed in line with the guidance provided in Paragraph 7 of Category II.E, Appendix B.

Description of Monitoring Methodology:

According to Appendix B of the simplified M&P for small-scale CDM project activities of the UNFCCC CDM website, the project has been identified to belong to Category II.E [***Energy efficiency and fuel switching measures for buildings***]. Paragraph 6 under Category II.E of the same document specifies that for the said category of CDM projects, **'In the case of a new facility, monitoring shall consist of:**

(a) Metering the energy use of the building(s);

(b) Calculating the energy savings of the new building(s).'

Paragraph 8 under Category II.E of the same document also specifies that for the said category of CDM projects, 'published values for technical transmission and distribution losses may be used. Alternatively technical transmission and distribution losses for the grid that supplies the building(s) may be monitored'. However, for the project activity under consideration, technical transmission and distribution losses for the grid that supplies the building "Technopolis", have not been taken into consideration in order to arrive at a conservative estimate of the emission reductions due to the project activity.

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	$E_{chiller,y}$
Data unit:	MWh
Description:	Electricity that will be consumed by the chiller plant of "Technopolis" in the project activity scenario
Source of data to be used:	BMS maintained log-sheets
Value of data	For the purpose of arriving at an estimate of the emission reductions, the impacts of the HRW on the heat load and on the electricity consumption have been considered in the chiller plant electricity consumption as per the energy simulation done for the HVAC system of "Technopolis". The value applied is 2646.941 MWh.
Description of measurement methods and procedures to be applied:	Continuous measurement of electrical energy consumption will be done by energy meters installed for each of the two operating chillers of "Technopolis". The electricity consumption by a chiller, will be recorded on an hourly basis in the BMS. Sum of the hourly electricity consumption by a chiller, for all operating hours of the chiller in a year, will yield the its annual value of electricity consumption for the year. Sum of the electricity consumption in each chiller, will provide the measure of total electricity consumption in chiller plant of "Technopolis" in the particular year.
QA/QC procedures to be applied:	Meters will be calibrated annually. The Maintenance Engineer will review the data on a monthly basis.
Any comment:	

Data / Parameter:	$E_{CT,y}$
Data unit:	MWh

Description:	Electricity that will be consumed by the cooling tower of "Technopolis" in the year y in the project activity scenario
Source of data to be used:	BMS maintained log-sheets
Value of data	396.286
Description of measurement methods and procedures to be applied:	Continuous measurement of electrical energy consumption will be done by energy meter installed for the cooling tower. The electricity consumption by the cooling tower, will be recorded on an hourly basis in the BMS. Sum of the hourly electricity consumption by the cooling tower, for all operating hours of the cooling tower in a year, will yield its annual value of electricity consumption for the year.
QA/QC procedures to be applied:	Meter will be calibrated annually. The Maintenance Engineer will review the data on a monthly basis.
Any comment:	

Data / Parameter:	$E_{pumps,y}$
Data unit:	MWh
Description:	Electricity that will be consumed by the chilled water pumping system (with VFDs in the pumps of the primary and secondary chilled water loops) of "Technopolis" in the year y in the project activity scenario
Source of data to be used:	BMS maintained log-sheets
Value of data	99.942
Description of measurement methods and procedures to be applied:	Continuous measurement of electrical energy consumption will be done by energy meters installed for each of the chilled water circulating pumps in the HVAC system. The electricity consumption by a pump, will be recorded on an hourly basis in the BMS. Sum of the hourly electricity consumption by the pump, for all operating hours of the chiller plant in a year, will yield the yearly value of electricity consumption of that pump for the year. Sum of the electricity consumption of each pump, will provide the measure of total electricity

	consumption in the chilled water pumping system of the HVAC system of "Technopolis" in the particular year.
QA/QC procedures to be applied:	Meters will be calibrated annually. The Maintenance Engineer will review the data on a monthly basis.
Any comment:	

Data / Parameter:	$E_{AHU,y}$
Data unit:	MWh
Description:	Electricity that will be consumed by the AHUs (with VFDs on fans and HRWs) of "Technopolis" in the year y in the project activity scenario
Source of data to be used:	BMS maintained log-sheets
Value of data	For the purpose of arriving at an estimate of the emission reductions, the electricity consumption of the all the fans in the AHUs have been considered and the value used is 593.304 MWh. The impact of the HRW on the heat load and on the electricity consumption have been considered in the chiller plant electricity consumption as per the energy simulation done for the HVAC system of "Technopolis".
Description of measurement methods and procedures to be applied:	Continuous measurement of electrical energy consumption will be done by energy meters installed for each of the 50 AHU rooms of "Technopolis". The electricity consumption by an AHU, will be recorded on an hourly basis in the BMS. Sum of the hourly electricity consumption by an AHU, for all operating hours of the AHU in a year, will yield the yearly value of electricity consumption of that AHU for the year. Sum of the electricity consumption in each AHU room, will provide the measure of total electricity consumption in AHUs of the HVAC system of "Technopolis" in the particular year.
QA/QC procedures to be applied:	Meters will be calibrated annually. The Maintenance Engineer will review the data on a monthly basis.

Any comment:	

Data / Parameter:	$\mathbf{T_{op,HVAC,y}}$
Data unit:	hours
Description:	Operating hours of the HVAC system of "Technopolis" in the year y in the project activity scenario
Source of data to be used:	BMS generated report for "Technopolis"
Value of data	16
Description of measurement methods and procedures to be applied:	The hours of operation of the HVAC system of "Technopolis" will be monitored continuously by the BMS. The total operating hours at the end of the year will yield $T_{op,HVAC,y}$
QA/QC procedures to be applied:	Not required
Any comment:	

Data / Parameter:	$E_{DG, y}$
Data unit:	kWh
Description:	Amount of electricity generated by Diesel Generator (DG) set that is consumed in "Technopolis" in year y
Source of data to be used:	Log-sheets maintained by PSL
Value of data	Not considered in emission reduction estimation since DG set will be operated only in case of exigencies
Description of measurement methods and procedures to be applied:	Continuous measurement through energy meter installed at the DG end
QA/QC procedures to be applied:	The Maintenance Engineer will review the data on a monthly basis
Any comment:	

Data / Parameter:	$E_{GRID, y}$
Data unit:	kWh
Description:	Amount of electricity drawn from the Eastern Regional Electricity grid by

	"Technopolis" in year y
Source of data to be used:	Log-sheets maintained by PSL
Value of data	Not considered in emission reduction estimation since it has been considered that DG set will be operated only in case of exigencies. So the reduction in electricity consumption in the HVAC system of "Technopolis" has been considered to affect the drawal of electricity from the Eastern Regional Electricity grid and there was no requirement to use the total electricity drawn from the grid.
Description of measurement methods and procedures to be applied:	Continuous measurement through net metering at main feeder.
QA/QC procedures to be applied:	The Maintenance Engineer will review the data on a monthly basis
Any comment:	

B.7.2 Description of the monitoring plan:

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PSL has designed a measurement and verification plan in order to ensure the proper, regular measurement and recording of the data pertaining to the energy conservation measures taken in "Technopolis". There is a Head – Facility Management, assisted by a Maintenance Engineer who will conduct monthly review of all the relevant data for the energy efficiency measures. They will also be responsible for proper archiving of data required for estimating emission reductions. There will be annual calibration of all the meters.

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

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Name of the responsible person(s)/entity(ies): Experts and consultants of PSL

Date of completion of the application of the baseline and monitoring methodology: 24/05/2007

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the small-scale project activity:

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C.1.1. Starting date of the small-scale project activity:

15/12/2004

C.1.2. Expected operational lifetime of the small-scale project activity:

20 years

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

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C.2.1. Renewable crediting period:

>>

NA

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

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NA

C.2.1.2. Length of the first crediting period:

>>

NA

C.2.2. Fixed crediting period:

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C.2.2.1. Starting date:

01/07/2007 or the date of registration with UNFCCC, whichever occurs later.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

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"Technopolis" is a place where the people have the opportunity to occupy spaces that have the maximum impact on their well-being and a minimal impact on the environment.

The consultants and contract managers for the HVAC system have certified that there is no CFC-based refrigerants in the HVAC and refrigeration systems used in Technopolis building. Apart from that, in view of the health hazards posed by tobacco smoke entering office work space, the entire Technopolis building is strictly a no-smoking zone. Air quality in each space is closely monitored through CO_2 sensors installed in return air path from various zones served by the air handling units. A log of indoor and outdoor CO_2 levels is maintained through an advanced IBMS. Care has been taken to ensure that all fresh air intakes are located at least 25 feet away from possible sources of contamination like building exhaust fans, cooling towers, standing water, parking, sanitary vents and outside smoking vents. High efficiency pre-filters are provided in supply air stream of all air handling units to remove any contaminants from outside air. In addition to that, continuous building flush out is conducted over a fourteen calendar day period to reduce possible indoor air quality contamination after completion of construction and prior to occupancy. This involves running the mechanical system with 100% outside air for the stipulated period of time. The purpose of this flushing out is to get rid of particulate matter and VOCs produced by particle emitting construction materials, furnishings, interior finishes and cleaning agents. Care is taken with regard to humidity levels and microbial growth depending on the seasonal weather conditions. All ventilation air filters are changed as a final step of building flush out.

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:

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Not applicable.

SECTION E. Stakeholders' comments

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

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Some of the major stakeholders identified for the project activity are Airports Authority of India (AAI), Bidhannagar Municipality, West Bengal Pollution Control Board, the different technology suppliers for the building, the technical consultants, the employees of Technopolis, the tenants who would be occupying the building and also the contract workers.

Some of the above stakeholders were involved in the project at various stages of obtaining the statutory clearances for the building. PSL has not only communicated with the relevant stakeholders under statutory obligations but also have engaged the other stakeholders in a proactive manner in expressing and accounting their opinions on the project. A newsletter was published during the inauguration of "Technopolis". Views of some of the relevant stakeholders on the energy efficiency in the HVAC system of the building were collated in the newsletter.

As a corporate policy of the company, Technopolis is engaged in an on-going initiative to educate all of their own employees and contractual workers. A series of programmes were administered at site.

E.2. Summary of the comments received:

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Comments received so far appreciate the energy efficiency measures taken in the HVAC system of "Technopolis".

Contractors

The contractors have commended the "Technopolis" project to be an exemplary energy efficient building. They have also commended the efforts of PSL towards registration of the project as a CDM project due to its potential of reducing electricity generation related GHG emissions.

Tenants

The tenants of the building commented that through the design and installations of the different energy efficiency measures, PSL has not only focussed on the comfort of the occupants but as a responsible corporate house, it has also prioritized the sustainable development of the country through optimum utilization of electricity.

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

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Views of some of the relevant stakeholders on the energy efficiency in the HVAC system of the building have been collated through notification on the project activity and the invitation of comments. The relevant comments and important clauses mentioned in the project documents / clearances like Detailed Project Report (DPR), EIA Report, local clearances, newsletter were considered while preparing the Project Design Document.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Phoenix Software Limited
Street/P.O.Box:	4/1, Red Cross Place
Building:	
City:	Kolkata
State/Region:	West Bengal
Postfix/ZIP:	700001
Country:	India
Telephone:	+91-33-2248/5901/4108/8883
FAX:	+91-33-2248 7843
E-Mail:	
URL:	www.technopolis.in
Represented by:	
Title:	Director
Salutation:	Mr
Last Name:	P
Middle Name:	K
First Name:	Banerjee
Department:	
Mobile:	-
Direct FAX:	
Direct tel:	
Personal E-Mail:	pkb@technopolisindia.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Till now funding from any Annex I party is not available.

Annex 3

BASELINE INFORMATION

The baseline building for the project activity would have comprised of the following features affecting the HVAC system.

Parameters affecting the HVAC system	Baseline Building
Exterior wall construction	(i) The wall would have been mass wall of U factor of 1.0 Btu/hr.ft^2 .^{0}F
Exposure of glass wall area	(vi) The glasses used would be plain glass. (vii) The U-value of the fenestration would be 1.0 Btu/hr.ft^2 .^{0}F on the north and non-north sides. (viii)The glass would have shading co-efficient of 0.656 on all sides. (ix) The glass would have 70% visible light transmittance on all sides. There would be no insulation in the space between the spandril and the sill areas
Roof Insulation	(i)The U-value of the roof would be 0.63 Btu/hr-ft^2-

Parameters affecting the HVAC system	Baseline Building
	^{0}F with R-15 over-deck insulation. (ii) Roof reflectivity would be 0.3. (iii)No terrace gardening would be there.
Air Handling Unit (AHU)	There would be no Heat Recovery Wheel (HRW).
Chillers	To meet the load demand, air cooled chillers with a full load efficiency of 1.17 kW/ton of refrigeration [kW/TR] (a co-efficient of performance i.e. COP of 3.0 at ARI conditions) would be used. Therefore, there would be no requirement for cooling tower.
Installation of VFD in the AHU	The AHUs would have provision for fresh air intake. The volume of fresh air planned would be 20ft^3/min (cfm) per person. Based on the occupancy planned, the quantity of fresh air brought in to the building would be approximately 100000 cfm which would be handled by the AHU coils on a continuous basis.

Parameters affecting the HVAC system	Baseline Building
Installation of VFDs in the chilled water pumping system	Chilled water would be pumped with a primary-secondary pumping arrangement. The primary loop pumps would circulate chilled water through the chillers, and the secondary pumps would distribute chilled water to the building. When the primary pumps, with motors operating at constant speeds are selected, they invariably have some extra head in the pump selection as compared to that of the actual demand at site. A balancing valve would be used after the chiller plant in order to introduce this non existing head in the primary loop. The electricity consumption of the pumps in the primary chilled water loop, therefore, would remain the same. However, VFDs would be installed in the secondary chilled water loop, to accommodate the variations in the building demand. The chilled water system would be designed for 2.67 Gallons/per minute (GPM) flow per TR.

With the above-mentioned features in place, the electricity consumption of the identified areas in the HVAC system of the baseline building, have been arrived at based on the data provided by the HVAC consultant of "Technopolis". The relevant data have been provided in Section B.6.2.

Annex 4

MONITORING INFORMATION

The project activity has employed the state-of-the-art monitoring and control equipment that will measure, record, report and monitor various key parameters like electricity consumption in the different areas of the HVAC system of "Technopolis".

The instrumentation system comprises of microprocessor-based instruments of reputed make with the best accuracy available. All instruments will be calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring and verification parameters.

Project Parameters affecting Emission Reduction Claims:

Monitoring:

GHG performance parameter and the emission reductions achieved through the project activity will be determined based on the following parameters:

- Electrical energy reduction from the energy efficiency measures taken in the building
- Emission factor for electricity generation in the Eastern Regional grid (calculated ex-ante for the project activity under consideration and the particular constant value is used for estimation of the emission reductions for the entire crediting period)

Please refer to Section B.7.1 for the details of the parameters that need to be monitored for calculation of the emission reductions arising out of the project activity.

CDM stands on the quantification of emission reduction and keeping the track of the emissions reduced. The project activity would reduce the carbon dioxide whereas an appropriate monitoring system would ensure this reduction is quantified and helps maintaining the required level.

Also a monitoring system brings about the flaws in the system if any are identified and opens up the opportunities for improvement.

The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and Reporting

Frequency of Monitoring

Since the emission reduction units from the project activity would be determined by the reduction in electrical energy consumption in the HVAC system, it becomes important for the project activity to monitor the reduced electricity consumption on real time basis. An on-line metering system will be in place to monitor and record the net electricity consumption in the HVAC system.

Reliability

As the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result:

- All measuring instruments will be calibrated by third party/ government agency once in a year for ensuring reliability of the system.
- The Standard Testing Laboratory (under Central/State Government) will verify the reliability of the meter readings; thereby ensuring the monitored results are highly reliable.

Registration and Reporting:

Registration of data would be on-line in the BMS as well as in log-books. Monthly reports would be prepared stating the electricity consumption and the operating hours of the HVAC system of "Technopolis"

The project proponent will also maintain a GHG performance procedure on a regular basis. All the monitored parameters will be recorded for crediting period plus two years.

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