SUSTAINABLE DEVELOPMENT BY GHG'S EMISSION REDUCTION

AT

INDIA GLYCOLS LIMITED, KASHIPUR, (UTTARAKHAND)

A PROJECT REPORT

Submitted by

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Roll. No. R070205003

in partial fulfillment for the award of the degree

of

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IN

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COLLEGE OF ENGINEERING

UNIVERSITY OF PETROLEUM & ENERGY STUDIES

DEHRADUN (UTTARAKHAND)

MAY 2007

INDIA GLYCOLS LIMITED

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IGL/PERS/KSP/2007/7

April 30, 2007.

CERTIFICATE

This is to certify that Mr. Amit Gupta, a student of M.Tech. in Health, Safety and Environment from University of Petroleum and Energy Studies, Dehradun, was on a Project Work with us from March 1, 2007 to April 30, 2007.

During this period he was attached with our HSE Department under Mr. RK Sharma, our Deputy General Manager. He has carried out a project on "Sustainable Development by Green House Gas Emission Reduction".

He was very regular and punctual during the period showing keen interest in learning and applying what he was learning.

We wish him the best for the future.

For India Glycols Limited

(S.DEVARAJAN)
Senior Manager (HRD)

UNIVERSITY OF PETROLEUM & ENERGY STUDIES, DEHRADUN, (U.K.)

BONAFIDE CERTIFICATE

Certified that this project report **"SUSTAINABLE DEVELOPMENT BY GREEN HOUSE GAS EMISSION REDUCTION "** is the bonafide work of **"Mr. AMIT GUPTA"** who carried out the project work under my supervision.

SIGNATURE

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PREFACE

The two months final semester major project report is prepared to submit to the, faculty of **University of Petroleum & Energy Studies (UPES), Dehradun (U.A.),** in partial fulfillment of **M. Tech. (Health, Safety & Environment)** course.

The **Health, Safety & Environment** is a separate and most important department in all the industries. It is basically concerned with protection of employees from occupational health hazards and accident/incident and protection of environment from the sources of pollution in the industry.

Generally training is considered to be one of the most important pillars in building up of professional carrier by giving training to each and every individual in his/her respective field.

The University of Petroleum & Energy Studies, Dehradun provides technical knowledge to their students of a two years full time M. Tech. courses and "Major Project" is must for the Technical students. This project report is also a result of two months summer training at India Glycols Limited, Kashipur.

This summer training provides me an opportunity to observe the actual working procedure and given me the basic knowledge about the CDM Project as a live example hope this knowledge will prove to be beneficial for me during my entire carrier.

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to **Mr. M.K. Rao Senior Vice President (WORKS), Mr. R.K.Sharma, DGM- HSE,** and **Mr. Devarajan, Sr.Manager, (P&A)** for having given me an opportunity to gain such a wonderful learning experience.

I would also like to express my sincere gratitude to **Mr. Jawaharlal Raina, Pro Vice Chancellor, UPES, and Dr. B.P.Pandey, Dean, COE, UPES.**

My sincere gratitude goes out to **Mr. R.K.Sharma, DGM- HSE, IGL, Kashipur,** who also happens to be my external guide for this project and **Dr. Nihal Anwar Siddiqui, Course coordinator M-Tech, HSE, UPES,** who is my internal guide for their valuable guidance, their support and their patience in helping me bring this major project to completion.

I am highly obliged to **Mr. Sarang Khati, Asst. Manager (Env. Engg.),** who were actively involved in guiding me in my project.

Their feedback was very helpful in bringing my project to a successful completion, so that I could visit their process units.

Finally I must offer my sincere gratitude to my parents, my friends and classmates for their help and support.

ABSTRACT

India Glycols Limited is the only company in the World to produce Mono Ethyl Glycol, Ethylene Oxide and EO derivatives from renewable agro feed stock–Molasses and sugar cane juice. IGL was incorporated on 19th November 1983. It started its commercial production of MEG on 25th April 1989, Ethoxylate on 25th January 1995 and Formulation/ Speciality chemicals on 1st September 1997.Its major products are Ethanol, MEG, DEG, TEG, Speciality chemicals, Guar gum Powder, Industrial Solvents, IMFL/Country liquor. India Glycols Limited is an ISO: 9001-2000 certified and listed public limited company, promoted by the Bhartiya Group.

In this Petrochemical Industry various types of work are carrying out for the processing of Molasses/ Sugar cane juice and to convert it into different types of products. For the fulfilment of this purpose Industry needs the energy supply. As we know that the present hot topic is the global warming so this industry is voluentrly has done the initiation, by starting the steam production with the help of the bagasse fired boiler in place of coal/oil fired boilers.

Objective of this project is to become more dependent upon the renewable sources (bio-mass) of energy rather than the non renewable sources of energy to conserve our precious Environment by reducing the amount of the Green House Gasses emissions, by this way the Organization will get the carbon credits for the purpose of sale to the other countries for the fulfilment of their obligations about GHG credits under Kyoto Protocol.

So that the Organization will get the capital for the improvement of the Environment as well as to improve the work culture of the entire industry for the well beings of the Environment, Occupational Health and Safety.

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List of symbols

PP	- Project Proponent
DOE	- Designated Operational Entities
AE	- Applicant Entity
EB	- Executive Board
COP	- Conference of the Parties to the Kyoto Protocol
MOP	-Meetings serving as the meeting of the Parties to the Kyoto Protocol
CER	- Certified Emission Reductions
DNA	- Designated National Authority
PDD	- Project Design Document
PCN	-Project Concept Note
PIN	-Project Information Note
IRR	-Investment Return Rate
IPCC	-Intergovernmental Panel on Climate Change
KL	-Kilo litter.
KNM^3	-Kilo Newton $Meater^3$.
NM^3	-Newton $Meater^3$.
MT.P.A	-Metric Ton Per Annum.
T.P.D	-Ton Per Day.
1 Case	-24 bottles.
P.M.	-Per Month.

INDIA GLYCOLS LIMITED:

[A] OVERVIEW:

- The company was incorporated on 19th November 1983. It started its commercial production of MEG on 25th April 1989. Ethoxylates on 25th January 1995 and Formulation /Specialty chemicals in 1st September 1997.
- India Glycols Limited is an ISO: 9001-2000 certified and listed public limited company, promoted by the Bhartiya Group.
- India Glycols limited is the only company in the world to produce MEG, EO and EO derivatives from renewable agro feed stock- Molasses and Sugar cane juice.
- India Glycols Limited has an integrated manufacturing approach for value addition.
- India Glycols Limited is the largest alcohol & EO Derivative Producer in INDIA.
- India Glycols Limited presently have manufacturing sites in Sugarcane rich belt of Kashipur (Uttrakhand) & Gorakhpur (U.P.).
- India Glycols Limited is planning to have a new manufacturing site in the state of BIHAR.
- Current turn over of India Glycols Limited is INR 8000 million in 2005-2006 and expected revenue in 2006-2007 as INR 11000 million (growth at 37%).
- India Glycols Limited has a share price value more than 10 times its face value.
- India Glycols Limited has a total of 800 employees out of which 400 employees are Science, Engineering and Management graduates.
- India Glycols Limited is the largest Private company in the Uttarakhand region.
- India Glycols Limited has won many prestigious safety awards by national safety council and from international certification agencies also.

[B] MANUFACTURING UNITS/PLANTS:

IGL consists of following production units:

Table1.1

Sl. No.	UNIT/PLANT	PRODUCT	DESIGN CAPACITY
1	Distillery	Ethanol	400Kl/Day
2	Bio-Gas	Bio gas (fuel)	150KNM3/Day
3	Air Separation unit 1& 2	Oxygen /Nitrogen	2200/990NM3/hr& 2000/750/NM3/hr
4	Air Separation Unit 3	liq.Oxygen/Liq.Nitrogen /Liq. Argon	2103NM^3/ 158 NM^3 / 232NM^3
5	M.E.G.	M.E.G., D.E.G.& T.E.G.	140000 MT.P.A.(MEG)
6	Ethoxylates	EO derivatives	20,000 MT.P.A.
7	Formulation	Specialty chemicals	10,000 MT.P.A.
9	Guar Gum	Guar gum powder	12,000 MT.P.A.
10	Glycol Ether	Industrial solvents	33,000 MT.P.A.
9	Bottling plant	IMFL/country Liquor	1Lac cases per month

FINISHED PRODUCTS OF INDIA GLYCOLS LIMITED AND THEIR USES

Table 1.2

Sl.No.	PRODUCT	USES
1	Mono Ethyl Glycol [M.E.G.]	Polyester staple fibbers , Polyester filament yarn, Packaging material, Explosives,coolants, Wire-enamels, unsaturated resins etc.
2	Di Ethyl Glycol [D.E.G.]	Pesticides , Rubber compounding , Break fluids, plasticizers, etc.
3	Tri Ethyl Glycol [T.E.G.]	Oil exploration and refinery.
4	E.O.Derivatives and specialty chemicals	Leather,textile, Wool scouring , Pesticides ,agrochemical , Cosmetics ,detergents , Medicines, emulsifiers, etc.
5	Glycol ether and Glycol ether acetate	Industrial solvents for paints, Break fluids ,coatings , Polymers and automotive industry.
6	Guar Gum	Food and its products e.g. ice-cream, bakery, chocolates, Cosmetics , Industrial application-explosives, textile, paper, oil – fields, chemicals, etc.
7	Liquors (IMFL & CL)	Beverages.
8	Rab (concentrated Juice)	Distillery.
9	Liquid Oxygen	Industrial gas.
10	Liquid Nitrogen	Industrial gas.
11	Liquid Argon	Industrial gas.
12	Bio gas	Using itself.

[C] UTILITIES:

Table 1.3

Sl.No.	UNIT/PLANT	PRODUCT	CAPACITY
A	**STEAM GENERATION**		MT/hour
1.	RFO-cum Bio Gas- IJT make:	HP steam at Pr 34kg/cm2 & temp 400°C	13.6 MT/hour
2	Coal –Bio Gas fired spreader Boiler- IJT make :	-do-	13.6 MT/hour
3	Coal –cum – Biogas fired fluidized bed combustion boiler- CVL make :	-do-	20 MT/hour
4	Coal —cum – biogas fired fluidized bed combustion boiler- TBW make :	-do-	50 MT/hour
5	Waste heat recovery boilers (DG exhaust gases based) – 3 nos.	MP steam at pressure 14 kg /cm^2 & temp 196 ^{0}C	1.5 MT/hour (01) 2.1 MT/hour (02)
6	FO fired- 30 TPH boiler.	HP steam at Pressure 40 kg / cm^2 & temp 460 ^{0}C	30 MT /Hour(01)
7	Bagasse Fired-45 TPH boiler	HP steam at Pressure 21 kg/cm^2 &temp.315+/-15^{0}C	45 MT/Hour(01)

B	**POWER GENERATION**		
1	Wartsila make –RFOFired D.G. (2 Nos.)	Electric power	03.2 MW each
2	Wartsila make – RFO fired D.G. Sets (2 nos.)	-do-	4.0 MW each
3	ABB make – TG. set	-do-	4.0 MW each
4	KKK – TG set (single extraction cum back pressure type)	-do-	2.6 MW each

SUSTAINABLE DEVELOPMENT:

Sustainable development is often defined as "development that meets the need of the present, But without compromising the ability of future generations to meet there own needs". Sustainable development encompasses three basic and inter-related objectives:

- Economic security and prosperity.
- Social development and advancement.
- Environmental sustainability.

2.1 Sustainable Development Demands:

To search the best ways of living, working and being that enable all people of the world to lead healthy, fulfilling, and economically secure lives without destroying the environment and without endangering the future welfare of people and the planet.

Sustainable development as applied to energy and environment should consider the following:

- Inputs –such as fuels and energy sources, land and raw materials –are non-renewable they should be used up only as far as they can be substituted in future.
- Where they are renewable they should be used up at a rate within which they can be renewed.
- Outputs –in production and consumption -should not overstrain ecosystems or the assimilation capacity of the ecosphere.

2.2 Why the need of the sustainable development arises: Complete summery.

- Human activities are increasing the concentration of Green House Gases ["GHG`S"] in atmosphere.
- This enhances the Green house effects, commonly known as **"Climate Change"**.
- Climate change leads to:
  - i) **Rise in average global temperature** [expected to go up by **1-4** ^{0} Celsius in next 100 years]. and the adverse effect of this will be shown in future.
  - ii) Changes in **precipitation** quantity and pattern
  - iii) Changes in **vegetation.**
  - iv) Increased **storm surges.**
  - v) **Sea level rise** [Parts of Maldives & Bangladesh might submerge in next 50 years]
  - vi) According to the IPCC surway till year 2100 the **Sea level will rise upto 40 cm** so near about 7 million people would be displaced from coastal regions.

Global temperature will rise so that **epidemic, dengue & malaria** infections will rise day by day.specially in Asian region.

DESCRIPTION OF RAB UNIT:

Rab unit consists of four types of processes, which are given below

3.1 Sugar Cane Milling:

Sugar cane received at the factory is weighted on platform scale and fed in to cane carrier by mechanical unloaders of grab type with tippler,the cane is prepared for crushing by the prepatory devices.

The prepatory devices consist of a kicker & fibrizor. The leveler has knives & fibrisor have hammers.

The knives rotate at about 600 RPM for cutting the cane travelling on the carrier .The knives cane is delivered to the fibrizor for being finally prepared for milling .The quality of preparation has a very significant role in the capacity and efficiency of the milling tandem called preparatory index. The milling plant usually consists of four mills each of three rollers, which are hydraulically loaded. The prepared cane passes through these mills where it is subjected to extracted juice repeatedly.

Final bagasse is discharged from last mill and juice is collected from mills and pumped to the boiling house for process. In the process of milling hot water is applied on the mills to increase the extraction of sugar.

In the system water is sprayed over the blanket of cane before last mill is called compound imbibition.the diluted juice from said mill is sprayed on the blanket to the proceeding mill and so on milling in this manner gives about 92-95% extraction. This bagasse is elevated by bagasse conveyor will go to boiler furnace for burning. Heat is utilised to generate steam at required pressure and temperature. The stem produced is used for power generation and move mill turbine as primer movers. The exhaust steam available from primer movers is utilised for process heating and evaporation etc.

3.2 Chemistry of Clarification:

The juice as extracted out of cane is composed of primary juice expressed by first crushing unit called first mill and diluted juice from second crushing unit called as secondary juice. Both these juices are combined together and termed as mixed juice. The mixed juice is a sugar solution which consist of about 80-84%water, 11-13%sucrose, 2.5-4%, non-sugar (impurities). The principal non-sugar are invert sugar (1.5%) and inorganic ash 0.5%. The mixed juice when sent for process is termed as raw juice and its pH ranges from 4.7-5.7.At this pH the juice is prone to microbial resulting sucrose present in juice under go to hydrolysis called inversion. Inversion reaction as follows

$$C_{12}H_{22}O_{11} \xrightarrow{\text{Invertase}} C_6H_{12}O_6 + C_6H_{12}O_6$$

Sucrose Glucose Fructose

It is advisable to process the juice as quickly as possible to prevent loss of sugar and to avoid oxidation, which causes coloration.

In order to achieve the maximum recovery of sugar, It is essential that the juice must be a free cell non-sucrose solid. The presence of each part of non-sugar in juice causes 0.4 part of sucrose to be non-crystaliable. Lower the purity of juice, larger is the amount of sucrose lost in the final molasses. To get rid of the impurities, the juice is subjected to clarification. Essentially, the good clarification process to be adopted is the once that enable maximum removal of impurities.

3.3 Defication Process:

This is the standard process followed with various modification such as defication, preliminary for obtain good quality of syrup (Rab). The juice is heated up to 75^0 C after making P_2O_5 level to 300 PPM. Optimum dose of milk of lime is added at deficator vessel to maintain pH to7.0 to 7.1.During this process phosphate and calcium salts are formed and the flocks absorb the impurities and colour. The important reactions in the clarification are the precipitation calcium phosphate. The reaction between lime & phosphate are complex in nature in juice due to its constituents such as organic acid, proteins, and inorganic compounds. Lime reacts with soluble phosphate & produce heavy tri calcium phosphate.

Chemistry:

$H_3PO_4 = 2H^+ + HPO_4^{-2}$

$HPO_4^{-2} = H^+ + PO_4^{-3}$

$Ca(OH)_2 = Ca^{++} + 2OH^-$

$3Ca^{++} + 2PO_4^{-3} = Ca_3(PO_4)_2$

The deficated juice is again heated upto 103^0C in the secondary juice heater and is allowed to settle in the continuous clarifier. The clear juice is drawn out from the clarifier and the mud is filtered in continuous rotary filtrate juice sent to recycle and press mud go out of process to used as agriculture etc.purpose.

3.4 Evaporation:

The juice as received from clarification station contains water and sucrose together with water added to the mills for purpose of maceration and water used for washing the filter cake. The clear juice is about 100%on cane with solid about 15% while temperature is increased to 110-120 ^{0}C.The clear juice is stored in clear juice tank from where it is pumped to the evaporator first body through clear juice heater.

The function of clear juice heater to raise the temperature of clear juice to boiling point temperature of the first vessel.

The evaporation is carried out in multiple effect evaporator (triple effect pressure evaporator). All multiple effect is vertical tube evaporator based on Rillieuxs principles. The saturated steam (exhaust of the prime movers) is admitted in calandria (steam space) of the first vessel where it is port with its latent heat to juice inside the vertical tubes and condensed. The condensates are continuously removed and fresh steam intake continuous. The condensate of first calendria, which has higher temperature and is free from sugar traces, is sent to the boiler feed tank through the pump. The condensate from the 2nd, 3rd & 4th calendria is removed by means of pumps through the system. Finally in bodies of multiple effect evaporate density of clear juice is increased then last body out let. The syrup (Rab) accumulating in the last vessel is evacuated by means of a pump and is sent to storage tank for inside plant use.

GLOBAL WARMING:

Before the industrial revolution, human activities released very few gases into the atmosphere and all climatic changes happened naturally.after the industrial revolution, through fossil fuel combustion, changing agricultural practices and deforestation, the natural composition of gases in the atmosphere is getting affected and climate and environment began to alter significantly.

Over the last 100 years, it was found out that the earth is getting warmer, unlike previous 8000 years when temperatures have been relatively constant. The present temperature is 0.3 – 0.6 ^{0}C warmer than it was 100 years ago.

The key Green House Gas [GHG] causing global warming is carbon di oxide.CFC`s even though they exist in very small quantities, are significant contributor to global warming.Carbon di oxide, one of the most prevalent green house gas in the atmosphere, has two major anthropogenic sources (Human Caused) .

- The combustion of fossil fuels and
- Changes in land use

Net release of carbon di oxide from these two sources is believed to be contributing to the rapid rise in atmospheric concentration since industrial revolution. Because estimates indicate that approximately 80% of all anthropogenic carbon di oxide emissions currently come from fossil fuel combustion, World energy use has emerged at the centre of the climate change debate.

4.1 Sources of Green House Gases:

Some green house gas occurs naturally in the atmosphere, while other results from human activities. Naturally occurring green house gases includes Water vapours [H_2O], Carbon di oxide [CO_2], Methane [CH_4], Nitrous oxide [N_2O], and Ozone [O_3].

Certain human activities, however, add to the levels of most of these naturally occurring gases. Carbon di oxide is released to the atmosphere when solid waste, fossil fuels [oil, natural gas, and coal] and wood and wood products are burned.

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emission also results from the decomposition of organic wastes in municipal solid waste landfills, and the raising of the livestocks. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

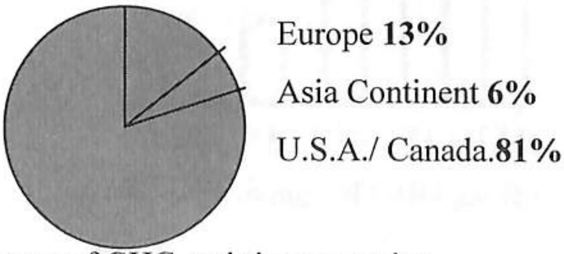
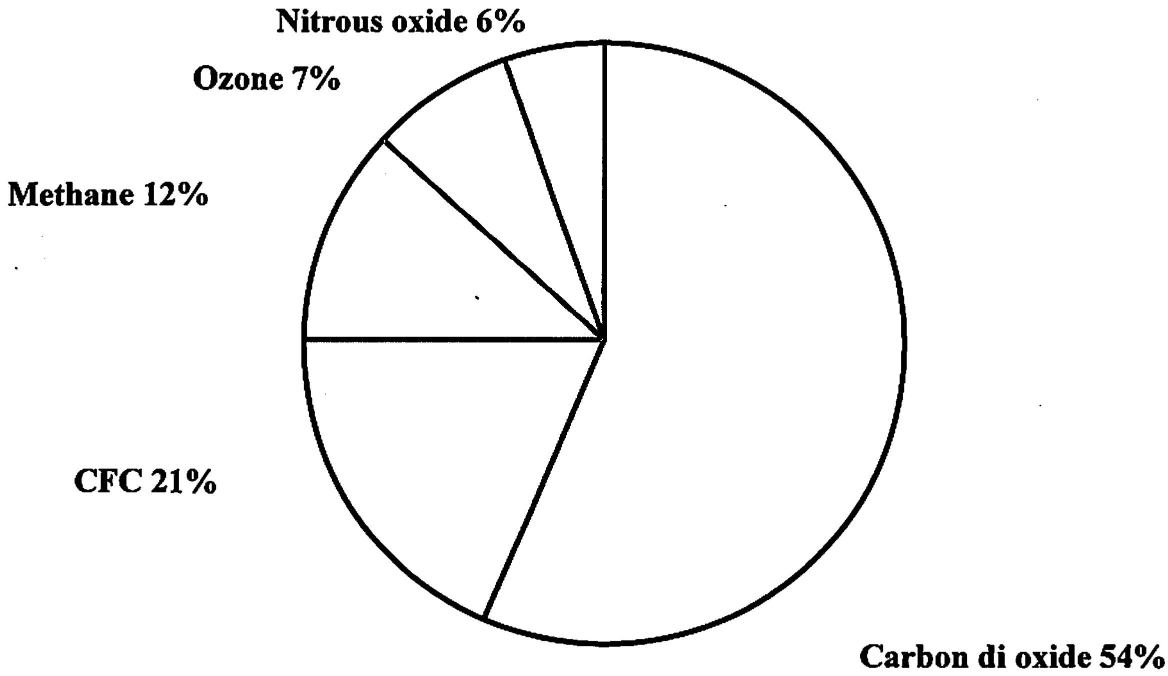


Figure4.1: Showing the percentage of GHG emitting countries.

Very powerful green house gases that are not naturally occurring include hydroflurocarbons [HCF`s], Perflurocarbons [PFC`s], and Sulphur hexafluoride [SF6], which are generated in a variety of industrial processes.

Often, estimates of Green House Gas emissions are presented in units of millions of metric tons of carbon equivalents [MMTCE], which weights each gas by its Global Warming Potential or GWP value.



Figures4.2: Showing the share of **Green House Gases** [GHGs] by pie chart.

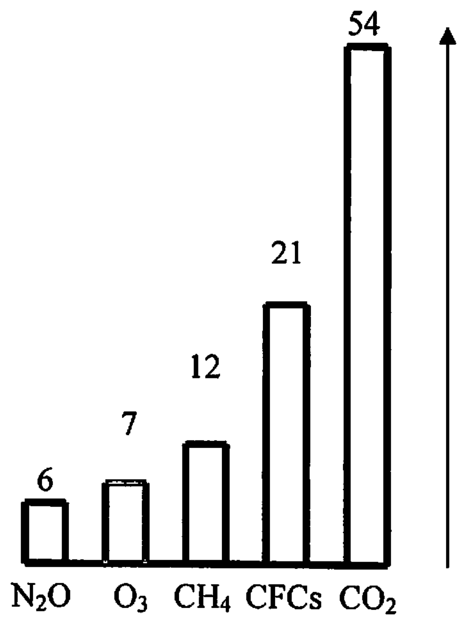


Figure4.3: Percentage of GHG gasses.

4.2.Global Warming Potentials:

Although there are a number of ways of measuring the strength of different greenhouse gases in the atmosphere, the Global Warming Potential (GWP) is perhaps the most useful. GWP measure the influence greenhouse gases have on the natural greenhouse effect, including the ability of greenhouse gas molecules to absorb or trap heat and the length of time, greenhouse gas molecules remain in the atmosphere before being removed or broken-down. In this way, the contribution that each greenhouse gas has towards global warming can be assessed.

Each greenhouse gas differs in its ability to absorb heat in the atmosphere. HFCs and PFC share the most heat-absorbent. Methane traps over 21 times more heat per molecule than carbon dioxide, and nitrous oxide absorbs 310 times more heat per molecule than carbon di oxide. Conventionally, the GWP of carbon dioxide, measured across all time horizons, is 1.

The GWP of other greenhouse gases are then measured relative to the GWP of carbon di oxide. Thus GWP of methane is 21 while GWP of nitrous oxide is 310.

Other greenhouse gases have much higher GWPs than carbon dioxide, but because their concentration in the atmosphere is much lower, carbon dioxide is still the most important greenhouse gas, contributing about 60% to the enhancement of the greenhouse effect.

The GWP values for different gases is given below in the table:

Table 4.1

Sl.No.	Name of the Gas	Chemical Formula	GWP Value
1.	Carbon di oxide	CO_2	01
2.	Methane	CH_4	21
3.	Nitrous oxide	N_2O	310
4.	Perfluro carbons	PFCs	9500
5.	Hydrofluro carbons	HFCs	11,700
6.	Sulfur hexa fluoride	SF6	23,900

4.3 Global Warming (Climate Change) Implications:

4.3.1 Rise in global temperature

Observations show that global temperatures have risen by about 0.6 °C over the 20th century. There is strong evidence now that most of the observed warming over the last 50 years is caused by human activities. Climate models predict that the global temperature will rise by about 6 °C by the year 2100.

4.3.2 Rise in sea level

In general, the faster the climate change, the greater will be the risk of damage. The mean sea level is expected to rise 9 - 88 cm by the year 2100, causing flooding of low lying areas and other damages.

4.3.3 Food shortages and hunger

Water resources will be affected as precipitation and evaporation patterns change around the world. this will affect agricultural output. Food security is likely to be threatened and some regions are likely to experience food shortages and hunger. Increase of every ½ ^{0}C temperature will reduce the wheat production by 17%.

4.3.4 India could be more at risks than many other countries

Models predict an average increase in temperature in India of 2.3 to 4.8°C for the benchmark doubling of Carbon-dioxide scenario. Temperature would rise more in Northern India than in Southern India. It is estimated that 7 million people would be displaced, 5700 km^2 of land and 4200 km of road would be lost, and wheat yields could decrease significantly.

4.3.5 Loss of Biodiversity:

Biodiversity refers to the variety of life on earth, and its biological diversity. The number of species of plants, animals, micro organisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all apart of a biologically diverse earth. Biodiversity actually boosts ecosystem productivity where each species, no matter how small, all have an important role to play and that it is in this combination that enables the ecosystem to possess the ability to prevent and recover from a variety of disasters.

It is now believed that human activity is changing Biodiversity and causing massive extinction. The World Resource Institute reports that there is a link between Biodiversity and climate change. Rapid global warming can affect ecosystem chances to adapt naturally.

Over the past 150 years, deforestation has contributed an estimated 30 percent of the atmospheric build-up of CO_2. It is also a significant driving force behind the loss of genes, species, and critical ecosystem services.

4.3.6 Death rate will increase:

The death rate would be increase in India due to its topography. The draught will increase in north India & south India will be caught by the flood.

4.3.7 Link between Biodiversity and Climate change

• Climate change is affecting species already threatened by multiple threats across the globe. Habitat fragmentation due to colonization, logging, agriculture and mining etc. are all contributing to further destruction of terrestrial habitats.

• Individual species may not be able to adapt. Species most threatened by climate change have small ranges, low population densities, restricted habitat requirements and patchy distribution.

• Ecosystems will generally shift northward or upward in altitude, but in some cases they will run out of space – as 10C change in temperature correspond to a 100 Km change in latitude, hence, average shift in habitat conditions by the year 2100 will be on the order of140 to 580 Km.

• Coral reef mortality may increase and erosion may be accelerated. Increase level of carbon di oxide adversely impacts the coral building process (calcification).

• Sea level may rise, engulfing low-lying areas causing disappearance of many islands, and extinction of endemic island species.

• Invasive species may be aided by climate change. Exotic species can out-compete native wildlife for space, food, water and other resources, and may also prey on native wildlife.

• Droughts and wildfires may increase. An increased risk of wildfires due to warming and drying out of vegetation is likely.

• Sustained climate change may change the competitive balance among species and might lead to forests destruction

4.3.8 Glacier will not remain present:

According to IPCC prediction, the Himalayan Glacier will be melted by the year 2035,then after the dangerous effect of the global warming will come in the front of the world.

CLIMATIC CHANGE PROBLEM AND RESPONSE:

In June 1992, the "United Nations Framework Convention on Climate Change" (UNFCCC) was signed in Rio de Janeiro by over 150 nations. The climate convention is the base for international co-operation within the climate change area. In the convention the climate problem's seriousness is stressed. There is a concern that human activities are enhancing the natural greenhouse effect, which can have serious consequences on human settlements and Eco-systems.

The convention's overall objective is the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

The principle commitment applying to parties of the convention is the adoption of policies and measures on the mitigation of climate change, by limiting anthropogenic emissions of greenhouse gases and protecting and enhancing greenhouse gas sinks and reservoirs. The commitment includes the preparation and communication of national inventories of greenhouse gases. The Climate convention does not have any quantitative targets or timetables for individual nations. However, the overall objective can be interpreted as stabilization of emissions of greenhouse gases by year 2000 at 1990 levels.

The deciding body of the climate convention is the Conference of Parties (COP). At the COP Meetings, obligations made by the parties are examined and the objectives and implementation of the climate convention are further defined and developed. The first COP was held in Berlin, Germany in 1995 and the latest (COP 10) was held in December 2004,Buenos Aires, Argentina.

5.1 The Kyoto Protocol:

There is a scientific consensus that human activities are causing global warming that could result in significant impacts such as sea level rise, changes in weather patterns and adverse health effects. As it became apparent that major nations such as the United States and Japan would not meet the voluntary stabilization target by 2000, Parties to the Convention decided in 1995 to enter into negotiations on a protocol to establish legally binding limitations or reductions in greenhouse gas emissions. The Parties decided that this round of negotiations would establish limitations only for the developed countries, including the former Communist countries (called Annexure I countries).

Negotiations on the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) were completed December 11, 1997, committing the industrialized nations to specify, legally binding reductions in emissions of six greenhouse gases. The 6major greenhouse gases covered by the protocol are Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), and sulfurhexafluoride (SF6).

5.2 Emissions Reductions:

The United States would be obligated under the Protocol to a cumulative reduction in its Green House Gas emissions of 7% below 1990 levels for three greenhouse gases (including carbon dioxide), and below 1995 levels for the three man-made gases, averaged over the commitment period 2008 to 2012.

The Protocol states that developed countries are committed, individually or jointly, to ensuring that their aggregate anthropogenic carbon dioxide equivalent emissions of Green House Gases do not exceed amounts assigned to each country with a view to reducing their overall emissions of such gases by at least 5% below 1990 levels in the commitment period 2008 to 2012.

The amounts for each country are listed as percentages of the base year, 1990 and range from 92% (a reduction of 8%) for most European countries to 110% (an increase of 10%) for Iceland.

5.3 Developing Country Responsibilities:

Another problematic area is that the treaty is ambiguous regarding the extent to which developing nations will participate in the effort to limit global emissions. The original 1992 climate treaty made it clear that, while the developed nations most responsible for the current buildup of greenhouse gases in the atmosphere should take the lead in combating climate change, developing nations also have a role to play in protecting the global climate. Per Capita CO_2 emissions are small in developing countries and developed nations have altered the atmosphere the most.

Developing countries, including India and China, do not have to commit to reductions in this first time period because their per-capita emissions are much lower than those of developed countries, and their economies are less able to absorb the initial costs of changing to cleaner fuels. They have not contributed significantly to today's levels of pollution that has been the product of the developed world's Industrial Revolution. The idea is that developing countries will be brought more actively into the agreement as new energy technologies develops and as they industrialize further.

5.4 Annex I Annex II &Non Annexure I Parties:

Annex I parties are countries which have commitments according to the Kyoto protocol. The entire Annex I parties are listed in the Table shown in the next page. Further Annex I parties shown in bold are also called Annex II parties. These Annex II parties have a special obligation to provide "new and additional financial sources" to developing countries (Non Annex I) to help them tackle climate change, as well as to facilitate the transfer of climate friendly technologies to both developing countries and to economies in transition. Commitments are presented as percentage of base year emission levels to be achieved during between 2008 –2012.

Non Annexure I Parties:

All the countries, which are not, come under the Kyoto protocol commitment comes in the Non Annexure I Parties. So all the developing countries come in the Non-Annexure I parties.the Non-Annexure I parties has no any obligation to reduce GHGs production, but they can initiate voluntary

List of Annex I and Annex II Parties:

European Union	%	Economies in transition to a market economy	%
Austria	92	Bulgaria	92
Belgium	92	Croatia	95
Denmark	92	Czech Republic	92
Finland	92	Estonia	92
France	92	Hungary	94
Germany	92	Latvia	92
Greece	92	Lithuania	92
Ireland	92	Poland	94
Italy	92	Romania	92
Luxembourg	92	Russian Federation	100
Netherlands	92	Slovakia	92
Portugal	92	Slovenia	92
Spain	92	Ukraine	100
Sweden	92		
United Kingdom	92		
Other Europe		Other Annex I	
Iceland	110	**Australia**	108
Liechtenstein	92	**Canada**	94
Monaco	92	**Japan**	94
Norway	101	**New Zealand**	100
Switzerland	92	**United States of America**	93

Base year is 1990 for all countries except those economies in transition, who may chose an alternative base year or multi-year period.

5.5 Actions required from developed and developing Nations:

The Kyoto Protocol does call on all Parties (developed and developing) to take a number of steps to formulate national and regional programs to improve "local emission factors,"activity data, models, and national inventories of greenhouse gas emissions and sinks that remove these gases from the atmosphere. All Parties are also committed to formulate, publish, and update climate change mitigation and adaptation measures, and to cooperate in promotion and transfer of environmentally sound technologies and in scientific and technical research on the climate system

5.5.1Who is bound by the Kyoto Protocol?

The Kyoto Protocol has to be signed and ratified by 55 countries (including those responsible for at least 55% of the developed world's 1990 carbon dioxide emissions) before it can enter into force. Now that Russia has ratified, this been achieved and the Protocol will enter into force on 16 February 2005.

5.6 India's Greenhouse Gas Emissions:

India has experienced a dramatic growth in fossil fuel CO_2 emissions and the data compiled by various agencies shows an increase of nearly 5.9 % since 1950. At present India is rated as the 6th largest contributor of CO_2 emissions behind China, the 2nd largest contributor. However, our per capita CO_2 of 0.93 tons per annum is well below the world average of 3.87tons per annum. Fossil fuel emissions in India continue to result largely from coal burning.

India is highly vulnerable to climate change, as its economy is heavily reliant on climate sensitive sectors like agriculture and forestry. The vast low-lying and densely populated coastline is susceptible to rise in sea level.

The energy sector is the largest contributor of carbon dioxide emissions in India. The national inventory of greenhouse gases indicates that 55% of the total national emissions come from energy sector. These include emissions from road transport, burning of traditional biomass fuels, coal mining and fugitive emissions from oil and natural gas.

Agriculture sector constitutes the next major contributor, accounting for nearly 34%. The emissions under this sector include those from enteric fermentation in domestic animals, manure management, rice cultivation, and burning of agriculture residues. Emissions from Industrial sector mainly came from cement production.

5.7 Indian Response to Climatic Change:

Under the UNFCCC, developing countries such as India do not have binding GHG mitigation commitments in recognition of their small contribution to the greenhouse problem as well as low financial and technical capacities. The Ministry of Environment and Forests is the nodal agency for

Climate change issues in India. It has constituted Working Groups on the UNFCCC and Kyoto Protocol. Work is currently in progress on India's initial National Communication (NATCOM) to the UNFCCC. India ratified the Kyoto Protocol in 2002

5.8 The Conference of the Parties (COP):

The Conference of the Parties is the supreme body of the Climate Change Convention. The vast majority of the world's countries are members (185 as of July 2001). The Convention enters into force for a country 90 days after that country ratifies it. The COP held its first session in 1995 and will continue to meet annually unless decided otherwise. However, various subsidiary bodies that advise and support the COP meet more frequently.

The Convention states that the COP must periodically examine the obligations of the Party and sand the institutional arrangements under the Convention. It should do this in light of the Convention's objective, the experience gained in its implementation, and the current state of scientific knowledge.

5.9 Exchange of Information:

The COP assesses information about policies and emissions that the Parties share with each other through their national communications. It also promotes and guides the development and periodic refinement of comparable methodologies, which are needed for quantifying net Green House Gas emissions and evaluating the effectiveness of measures to limit them. Based on the information available, the COP assesses the Parties efforts to meet their treaty commitments and adopts and publishes regular reports on the Convention's implementation. Support for Developing countries

Developing countries need support so that they can submit their national communications, adapt to the adverse effects of climate change, and obtain environmentally sound technologies. The COP therefore oversees the provision of new and additional resources by developed countries. The third session of the Conference of the Parties adopted the Kyoto Protocol.

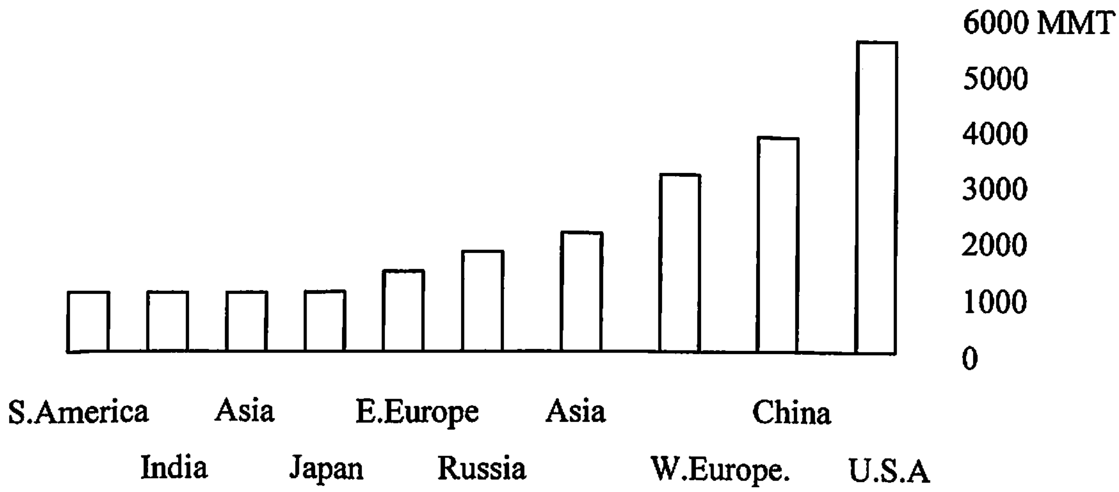


Figure: 5.1.Comparative graph of the most frequent CO_2 emitting countries:

Chapter: 6

MECHANISMS FOR SUSTAINABLE DEVELOPMENT:

The Kyoto protocol gives the Annex I countries the option to fulfill a part of their commitments through three "flexible mechanisms". Through these mechanisms, a country can fulfill a part of their emissions reductions in another country or buy emission allowances from another country. There are three flexible mechanisms:

i. Emissions trading

ii. Joint implementation

iii. Clean development mechanism

6.1 Emissions trading

Article 17 of the Kyoto protocol opens up for emissions trading between countries that have made commitments to reduce greenhouse gas emissions. The countries have the option to delegate this right of emissions trading to companies or other organisations. In a system for emissions trading, the total amount of emissions permitted is pre-defined. The corresponding emissions allowances are then issued to the emitting installations through auction or issued freely. Through trading, installations with low costs for reduction are stimulated to make reductions and sell their surplus of emissions allowances to organisations where reductions are more expensive. Both the selling and buying company wins on this flexibility that trade offers with positive effects on economy, resource efficiency and climate.

The environmental advantage is that one knows, in advance, the amount of greenhouse gases that will be emitted. The economical advantage is that the reductions are done where the reduction costs are the lowest. The system allows for a cost-effective way to reach a predefine target and stimulates environmental technology development.

6.2 Joint Implementation, [JI]

Under article 6 of the Kyoto protocol an Annex I country that has made a commitment for reducing greenhouse gases, can offer to, or obtain from another Annex I country green house gas emissions reductions. These emissions reductions shall come from projects with the objectives to reduce anthropogenic emissions from sources or increase the anthropogenic [man-made] uptake in sinks. In order to be accepted as JI-projects, the projects have to be accepted by both parties in advance. It also has to be proven that the projects will lead to emissions reductions that are higher than what otherwise would have been obtained. JI-projects are an instrument for one industrial country to invest in another industrial country and in return obtain emissions reductions. These reductions can be used to help fulfill their own reduction commitments at a lower cost than if they had to do the reductions in their own country.

CLEAN DEVELOPMENT MECHANISM (CDM):

Article 12 of the Kyoto protocol defines the Clean Development Mechanism, CDM. The purpose of CDM is to:

a) Contribute to sustainable development in developing countries;

b) Help Annex I-countries under the Kyoto Protocol to meet their target.

With the help of CDM, countries which have set themselves an emission reduction target under the Kyoto Protocol (Annex I countries) can contribute to the financing of projects in developing Countries (Non-Annex I countries) which do not have a reduction target. These projects should reduce the emission of greenhouse gases while contributing to the sustainable development of the host country involved. The achieved emission reductions can be purchased by the Annex I country in order to meet its reduction target. In order to be accepted as CDM-projects, the projects have to be accepted by both parties in advance. It also has to be proven that the projects will lead to emissions reductions that are higher than what otherwise would have been obtained. The difference between JI-projects and CDM-projects is that JI-projects are done between countries that both have commitments, while the CDM-projects is between one country that has commitments and another country that does not have commitments. Emissions reductions that have been done through CDM-projects during the period 2000 to 2007 can be used for fulfilling commitments in Annex I countries for the period 2008-2012.

7.1 How CDM works?

An investor from a developed country, can invest in, or provide finance for a project in a developing country that reduces greenhouse gas emissions so that they are lower than they would have been without the extra investment – i.e. compared to what would have happened without the CDM under a business as usual outcome. The investor then gets credits – carbon credits - for the reductions and can use those credits to meet their Kyoto target. If the CDM works perfectly it will not result in more or less emission reductions being achieved than were agreed under the Kyoto Protocol, it will simply change the location in which some of the reductions will happen. For example, a French company needs to reduce its emissions as part of its contribution to meeting France's emission reduction target under the Kyoto Protocol. Instead of reducing emissions from its own activities in France, the company provides funding for the construction of a new biomass plant in India that would not have been able to go ahead without this investment. This, they argue, prevents the construction of new fossil-fueled plants in India, or displaces consumption of electricity from existing ones, leading to a reduction in green house gas emissions in India. The French investor gets credit for those reductions and can use them to help meet their reduction target in France.

7.2 Requirements for Participating in CDM:

7.2.1 Criteria:

All Annexure I and Non-Annexure I Nation must meet three requirements for participation in CDM.

- Voluntary Participation.
- Establishment of National CDM Authority.
- Rectification of Kyoto Protocol.

In additional Annexure I Nations must establish:

- The assigned amount under Article 3 of the protocol.
- A National system for the establishment of GHG.
- A National registry.
- An annual inventory.
- An accounting system for the sale and purchase of emission reduction.

7.2.2 Eligible projects:

- The CDM can include the following projects:
- End use energy efficiency improvement.
- Supply side energy efficiency improvement.
- Renewable energy.
- Fuel switching.
- Agriculture [reduction of CH_4 and N_2O emission].
- Industrial processes [CO_2 from cement etc., HCFs, PFCs, and SF6].
- Sinks projects [Only afforestation and reforestation]

Note: Annexure I Nations must refrain from using CERs generated through nuclear energy to meet their targets.

7.3 Project cycle for CDM:

The project cycle for CDM is shown in Figure. There are seven basic stages; the first four stages are performed prior to the implementation of the project, while the last three stages are performed during the lifetime of the project.

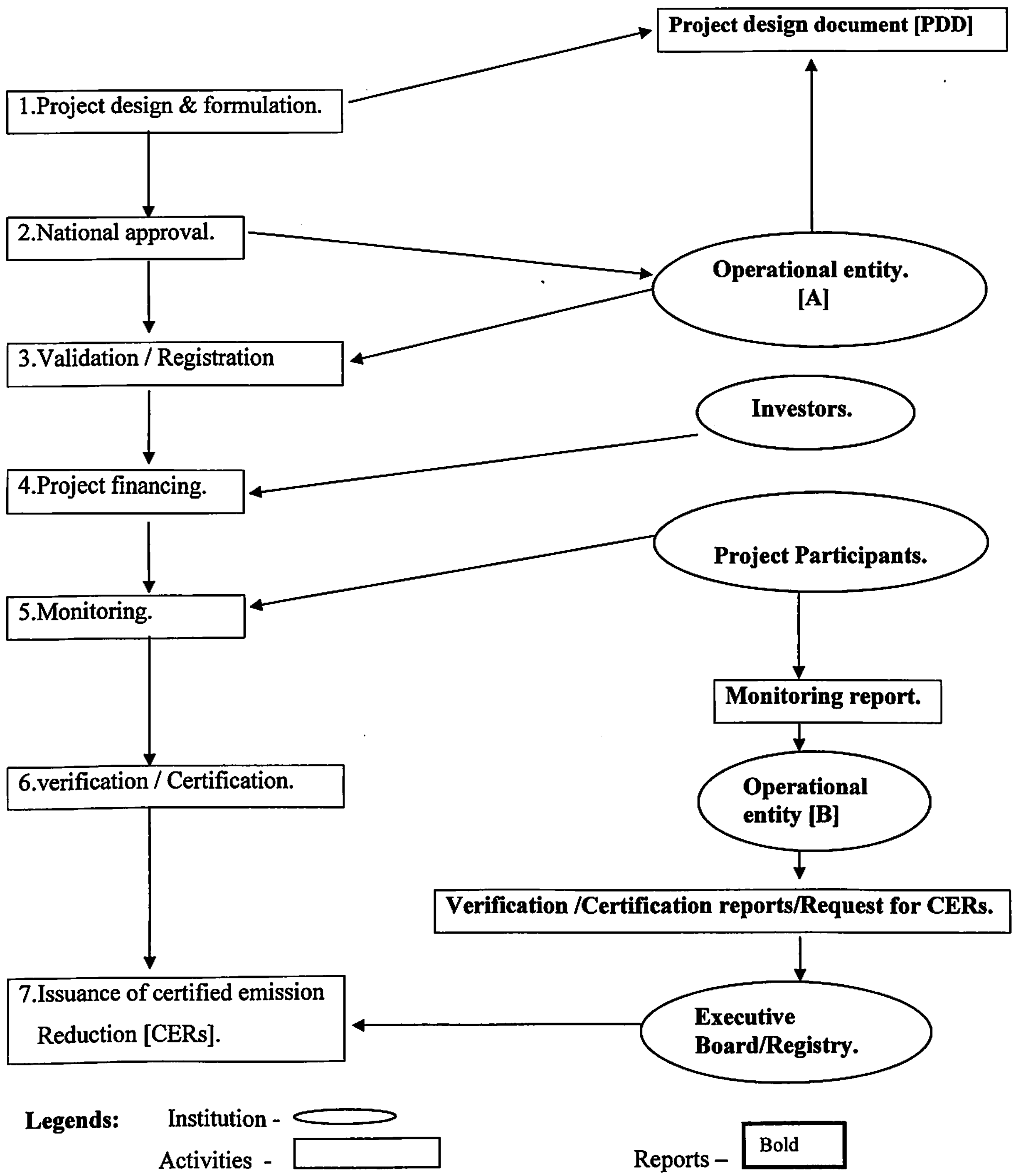


Figure7.1: Project Cycle for CDM.

While investor's profit from CDM projects by obtaining reductions at costs lower than in there own countries, the gains to the developing country host parties are in the form of finance, technology, and sustainable development benefits. Projects starting in the year 2000 are eligible to earn Certified Emission Reductions (CERs)

If they lead to **"Real, measurable, and long-term"** GHG reductions, which are additional to any that, would occur in the absence of the CDM project. This includes afforestation and reforestation projects, which lead to the sequestration of carbon dioxide.

At COP-7, it was decided that the following types of projects would qualify for fast track approval procedures:

- Renewable energy projects with output capacity up to 15 MW
- Energy efficiency improvement projects which reduce energy consumption on the supply and / or demand side by up to 15 GWh annually
- Other project activities that both reduce emissions by sources and directly emit less than 15 kilotons CO_2 equivalent annually.

An executive board will supervise the CDM, and a share of the proceeds from project activities will be used to assist developing countries in meeting the costs of adaptation to climate change.

7.4 Indian Initiatives on CDM:

Government of India has been willing to fulfill its responsibility under the CDM. It has developed an interim criterion for approval of CDM project activities, which is now available to stakeholders. It has undertaken various capacities building activities like holding of workshops, initiation of various studies, and briefing meeting with the stakeholders. India has been actively participating in the CDM regime and has already approved projects for further development.

Under CDM, projects such as energy efficient hydrocarbon refrigerators, modernization of small-scale foundry units and renovation, modernization of thermal power stations etc. are being taken up.

7.4.1 Case Example:

In a power plant renovation and modernization program by replacing plant equipment which are prone to wear and tear over a period of time, such as boilers and auxiliaries, turbine blades, HP governor valves and station auxiliaries which include material handling equipment, water treatment, pulverisers, ash handling plant, ESP etc resulted in CO_2emission reduction from 1.20 kg/kWh to 1.11 kg/kWh. The details are shown in the Table 7.0 presented in the next page.

Efficiency Improvement and Emission Reduction in a Power Plant Modernisation Program:

Table7.1

Parameters	Before the program	After the program
Gross heat rate (kcal/kWh)	2700	2500
Net efficiency (%)	28	30
Specific coal consumption	0.77	0.71
Total CO_2 emissions (tones/year)	1435336	1329015
CO_2 emissions (kg/ kWh)	1.20	1.11

7.5 Prototype Carbon Fund (PCF):

Recognizing that global warming will have the most impact on its borrowing client countries, the World Bank approved the establishment of the Prototype Carbon Fund (PCF). The PCF is intended to invest in projects that will produce high quality greenhouse gas emission reductions that could be registered with the United Nations Framework Convention on Climate Change (UNFCCC) for the purposes of the Kyoto Protocol. To increase the likelihood that the reductions will be recognized by the Parties to the UNFCCC, independent experts will follow validation, verification and certification procedures that respond to UNFCCC rules as they develop. The PCF will pilot production of emission reductions within the framework of Joint Implementation (JI) and the Clean Development Mechanism (CDM). The PCF will invest contributions made by companies and governments in projects designed to produce emission reductions fully consistent with the Kyoto Protocol and the emerging framework for JI and the CDM. Contributors, or "Participants" in the PCF, will receive a pro rata share of the emission reductions, verified and certified in accordance with agreements reached with the respective countries "hosting" the projects.

7.6 Size of Market for Emissions Reductions:

- All estimates of market volume are speculative at this early stage in the market's development.
- One way of looking at the potential size of the market is to assume that about one billion tons of carbon emissions must be reduced per year during the commitment period of 2008-2012 in order for the industrialized countries to meet their obligations of a 5% reduction in their 1990 levels of emissions. Under Prototype carbon fund program of the World Bank. Government of India has approved a municipal solid waste energy project for implementation in Chennai, which proposes to use the state of art technology for extracting energy from any solid waste irrespective of the energy content. Many industrial organisations in the private sector have also sought assistance under this fund.

INTRODUCTION TO CARBON ACCOUNTING:

GHG accounting is one of the fundamental tools required if a company, industry, or government is going to design a carbon management strategy. Accounting protocols are necessary for defining a baseline level of GHG emissions and measuring progress toward emissions mitigation targets. Credible accounting and reporting of GHG emissions are prerequisites for demonstrating compliance with many current (and future) government regulations and for participation in carbon trading markets. In addition, at a company level, emissions measurement through standardized protocols plays an essential role in business planning, strategy development and performance assessment against organizational objectives.

Greenhouse gas emission accounting and reporting protocols may be broadly classified into four categories:

- **International protocols** developed by governmental and non-governmental agencies (e.g., IPCC emissions accounting methodology and the WBCSD/WRI GHG protocol),
- **National protocols** designed to standardize emissions reporting within a country (e.g. protocols/methodologies established by the Australian Greenhouse Office and U.S. EPA),
- **Industry-specific protocols** developed to standardize emissions reporting within an industry (e.g., WBCSD cement industry protocol and GEMI methodology), and
- **Corporate protocols** developed by proactive organizations in order to manage GHG emissions, verify their Eco-efficiency, or assess energy efficiency.

A sample list of tools available for companies conducting GHG emissions inventories is shown in table below. These tools range from computer programs to detailed guidance manuals, some of which were developed for specific industries or emissions sources

Resources for Estimating Greenhouse Gas Emissions

Table 8.1

Resource	Scope	Comments
Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories	Estimation methods for the major sources of direct and indirect greenhouse gases.	Developed for national level inventories, but may be useful for company-level inventories in the absence of other data.
U.S. Department Of Energy (DOE), Lawrence Berkeley National Laboratory	Guidelines for Monitoring, Evaluation, Reporting, Verification and Certification of Energy Efficiency Projects for Climate Change Mitigation, Monitoring, Evaluation; Reporting, Verification and Certification of Climate Change Mitigation Projects; Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines.	Successors to International Performance Monitoring and Verification for energy efficiency projects. Other related reports also available. Focus in on energy-related emissions, rather than industrial emissions of GHGs.
Australian Greenhouse Office • National Greenhouse Gas Inventory Committee Workbooks; and • Greenhouse Challenge Vegetation Sinks Workbook	Workbooks on national emissions inventory with supplements for state and territory governments. Step-by-step procedures for estimating carbon sequestration. Focuses on forest-based sinks.	Workbooks for all topics available from AGO Website at: http://www.greenhouse.gov.au
U.S. EPA Emissions Inventory Improvement Program, Volume 8, Greenhouse Gases	Fourteen-chapter volume designed to provide guidance to states on estimating emissions of each of the Kyoto GHGs.	Available at: www.epa.gov/ttn/chief/eiip/techrep.htm#green

Resource	Scope	Comments
Global Environment Management Initiative (GEMI)	Overview of corporate GHG emissions inventory process; contains links to other resources.	See "Measurements and Metrics" section of: www.businessandclimate.org
U.K. Department of Environment, Transport, and Regions Guidelines for Company Reporting on GHG Emissions	Manual on GHG emissions reporting for voluntary reporting by companies. Covers Kyoto gases.	Provides guidelines on boundary questions as well as emissions estimation for fossil fuel combustion. Includes list of guides for sector-specific emissions. Available at: www.environment.detr.gov.uk / envrp/gas
U.S. DOE 1605b	Guidance for participants in the DOE's 1605b program on the estimation and reporting of GHGs emissions and emissions reduction projects.	Estimation methods focus on emissions from fossil fuel combustion (incl. transportation), forestry, and agricultural sectors. Available at: www.eia.doe.gov/oiaf/1605/ guidlins.html
U.S. EPA AP-42	Compilation of conventional and GHG air pollutant emissions factors for stationary sources.	Available at: www.epa.gov/ttn/chief/ap42.html
U.S. EPA Climate Wise	Software for tracking GHG and conventional pollutant emissions, energy use, and costs at the process unit, facility and company level.	Distribution of software is currently limited to participants in the Climate Wise Program.

World Business Council for Sustainable Development / World Resources Institute	Standardized, international, GHG emissions reporting protocol. Website also contains a wide range of inventory resources and related materials.	See "Resources" section at www.ghgprotocol.org
Winrock International Institute for Agricultural Development	Methods for inventorying and monitoring carbon in forestry and agroforestry projects.	Publications, bibliography, and case studies available at: www.winrock.org/REEP / forest_carbon_monitoring_ program.html
World Bank Greenhouse Gas Assessment Handbook	GHG emissions assessment methodologies for energy, industrial, and land use projects.	Designed for evaluation of World Bank sponsored projects. Available under "Tool Kit for Task Managers" at: www.esd-worldbank.org/cc
Gas Research Institute GRI-GHGCalc™	Personal computer program to calculate methane, carbon dioxide, and nitrous oxide emissions from natural gas operations.	Software description and ordering information available at: www.gri.org/pub/content/jan/ 20000117/115155/ghgcalc.ht ml

Source: Pew Center for Global Climate Change

There are important linkages between national inventories and corporate inventories. Generally speaking, national GHG inventories are conducted independent of corporate inventories. They are typically conducted on a top-down basis using national activity data, rather than facility-level data. On the other hand, corporate inventories are generally conducted on a bottom-up basis by summing up emissions from individual plants or facilities.

In addition to following accepted accounting and estimating practices, two basic requirements for a useful protocol include: 1) being systematic and user-friendly, so that it does not take an inordinate effort to follow it; and 2) being developed with some anticipation of future carbon reporting developments and requirements, so that major rework will not be required by protocol users in the future. For national level accounting there is internationally approved IPCC Guidelines for National

Greenhouse Gas Inventories. The IPCC guidelines also provide a basis for expressing emissions of GHGs on a common basis (IPCC, 1996). Because GHGs vary in their "greenhouse potential", the IPCC developed a Global Warming Potential (GWP) for each gas. The GWP expresses the warming effectiveness of gas over a given time span relative to carbon dioxide. This allows meaningful comparisons of GHG emissions when expressed in CO_2 equivalents.

8.1 GHG protocol initiative:

For doing corporate level accounting, World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) have developed a GHG Protocol. The GHG Protocol is an international collaboration of industry, NGOs, government and inter-governmental organizations. The objective of the initiative is "to develop internationally accepted accounting and reporting standards for GHG emissions and promotes their use in companies and other organizations." The protocol is consistent with the IPCC practices, but more detailed and tailored to industrial use. The GHG Protocol initiative also consists of project accounting module.

It is extremely unlikely that there will be one single accepted accounting protocol. However, these protocols may be used as the starting point for the development of a customized accounting standard for a specific company or industry group. A Pew Center for Global ClimateChange [2000] study on Green House Gas inventory issues suggests the following guideline principles for developing effective GHG emission inventory program.
Being the most accepted GHG accounting tool internationally for corporate accounting, India Glycols Limited has used this model as a basis for setting up its GHG accounting framework.

8.2 WBCSD/ WRI GHG Protocol:

8.2.1 Corporate account and reporting standard elements:

- GHG accounting principles.
- Setting reporting boundaries for the company, this involves various dimensions such as accounting for emission from partially owned entities, and accounting for direct and indirect emissions.
- Setting a historic performance datum.
- Reporting GHG emission data.

8.2.2 Guidance section elements:

- Defining business goals in relation to GHG reporting.
- Accounting for GHG reduction projects.
- Identifying and calculating GHG emission.
- Managing inventory quality.
- Verifying GHG emission data.

8.2.3 Calculation tools:

There are two broad categories of calculation tools in the protocol:

a. Sector - specific tools.

b. Cross – sector tools.

a) Sector - specific tools:

- Aluminium
- Iron & steel.
- Nitric acid.
- Ammonia.
- Adipic acid.
- Cement.
- Lime.
- Office based organization.
- Pulp & paper mills.
- HFC- 23 from HCFC –22 production.
- Semi conductors.

b) Cross – sector tools:

- Stationary combustion.
- Mobile combustion.
- Measurement and estimation uncertainty.

CDM PROJECT ACTIVITY:

9.1 Title of the Project activity:

Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd. Kashipur

9.1.1 Description of the Project activity:

9.1.2 Purpose:

The purpose of the project activity to utilize bagasse available in the Rab Unit of M/s India Glycols Ltd for effective generation of steam for captive use. Steam generated from biomass fired boiler is used in six turbo turbines of total 3200 BHP and replace fossil fuel fired boiler available in M/s India Glycols Ltd.

The project activity will help in reducing Green House Gases emitted during use of RFO/Coal in boilers and conserve the natural resources of energy.

9.2 Salient feature of project:

9.2.1 Availability of Bagasse:

In the process of Rab unit, cane is crushed in crusher to extract the juice; this juice is further processed to Ethyl Alcohol in distillery. In this process of crushing a fibrous material bagasse is produced as by-product. The combustion of bagasse as biomass will permit the steam generation from the boiler to qualify as renewable fuel. This steam is used in turbine generator as well as to meet other process requirements.

9.2.2 Project activity's contribution to sustainable development

Project activity assists in achieving sustainable development, as well as it is oriented towards improving the quality of life from the environmental standpoint.

9.2.3 Social well being:

The contribution to sustainable development of this project is significant not only through the provision of appropriate consumption of electricity as demand and supply of electricity is not sufficient in the area but also it plays positive role in the local economy.

The role of M/s India Glycols Ltd. in the local rural economy may be separated into the following two categories:

- **Direct employment affects** – farmers supplying cane and factory workers
- **Indirect employment affects** – growth in surrounding area.

9.2.4 Economic well being:

The project activity brings in additional investment consistent with the needs of the people specially farmers of the area, as Kashipur comes under rural area and farming is main sources of income in the area.

- Cash payment of sugarcane to local farmers
- Providing good quality manure in cheep rate.
- Providing technical assistance to the farmers
- The project activity generates employment in the local area.
- The project creates a business opportunity for local stakeholders such as bankers, consultants, suppliers, manufacturers, contractors etc.

9.2.5 Environmental well being:

- Project activity is mainly to save natural resource of energy as diesel/coal to provide sustainable development.
- The project uses only biomass and it is a step towards saving exploitation of petroleum & coal (non renewable energy sources)
- Since the project uses only biomass (carbon neutral fuel) materials for steam generation; it does not lead to GHG emissions.
- Encouraging farmers for sugarcane farming to maintain Eco-system in the region.

9.2.6 Technological well being:

- The technology selected for the project of steam generation is a modern and energy efficient one using a steam turbo turbine with matching boiler capable of firing biomass as fuel.
- As cane juice will be raw material for distillery to generate alcohol, quantity of spent wash generation will be low compare to use of molasses as raw material. Improvement in raw material will increase efficiency of distillery.

9.2.7 Project participants:

Project promoter and official contact of project activity-

M/s India Glycols Ltd.,

Kashipur,

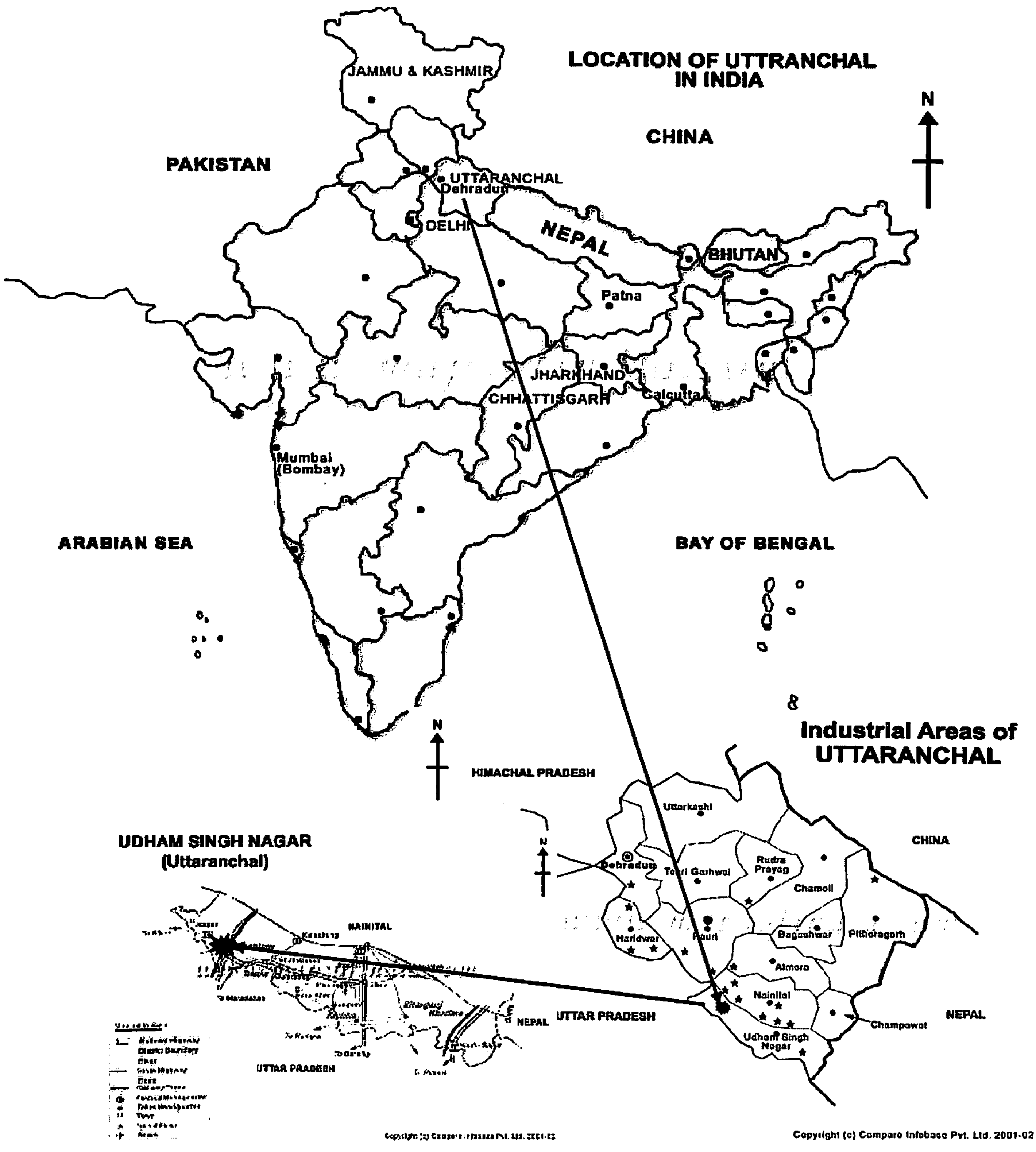
Dist: Udham Singh Nagar,

State: Uttarakhand.

Country: India

9.3 Detail of Physical location, including information allowing the unique identification of this project activity:

The project has been implemented at M/S INDIA GLYCOLS LTD. company's manufacturing facility at Rab Unit in Kashipur Bajpur road 8.0 km from Kashipur. The bagasse fired boiler project has been constructed in eastern side of M/s India Glycols Ltd., which is a part of the Rab unit. Kashipur is 270 km from Delhi & 50 km from Moradabad at 74 number highway and come in District U.S. Nagar & State Uttarakhand.



9.3.1 Environmental Impacts of the Proposed Project:

In relation to the baseline scenario no negative environmental impacts will arise as a result of the project activity.

The positive environmental impacts arising from the project activity are:

- A reduction in carbon di oxide emissions from the replacement of fossil fuels, which would be under the baseline scenario.

However the design philosophy of this project activity driven by the concept of providing the low cost energy with acceptable impact on the environment hence the environment aspects of the project activity are discuss as follows:

- The major environmental issue related to the project activity is the ash disposal methodology.

Bottom ash disposal system:

Bulk of the ash is collected from dust collector as bottom ash and rest to be collected from. Economiser, air-pre heater .To dispose of these ashes the following system is adopted.

- Bottom ash from the boiler is collected separately and it will use for land filling.
- Fly ash collection & disposal system.

Note: The project does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India.

9.3.2 Category of project activity:

Main Category:

Type I – Renewable energy power project

Sub Category:
C- Thermal energy for captive use

This category comprises renewable energy technologies that supply individual households or users with thermal energy that displaces fossil fuels or non-renewable sources of biomass5.

The project activity is biomass based power project. The installed designed capacity of boiler is 45 tons / hr, 21.0 kgf/cm^2 pressure & 315 + / - 15 °C. Steam will mainly use to run 3200 BHP turbo turbine (4 turbines of 600 BHP & 2 turbines of 400 BHP).

Project is less than the limit of 15 MW for renewable energy project activity to qualify under Type I project activity.

Biomass- based systems that produce heat by firing in boiler to produce steam of for captive use as running turbo turbine of 3.4 MW (3200 BHP) is included in this category.

Prior to project activity the steam requirement of M/S INDIA GLYCOLS LTD. was met by Coal/RFO/Biogas fired different boilers of different capacities. These boilers were owned and operated by M/S INDIA GLYCOLS LTD. and generate steam as per requirement of plant. Rab unit is a part of M/S INDIA GLYCOLS LTD. needs steam to run turbo turbine (3200 BHP) and process requirement can get steam from boiler available in M/S INDIA GLYCOLS LTD. by increasing fuel load.

9.3.3 Technology to be employed by the project activity:

Project is biomass fired boiler for steam generation. The purposes of project essentially to utilize biomass effectively, available in Rab unit as well as other sugar plants in the reason and replace fossil fuels consumption.

9.3.4 Standard analysis of biomass (bagasse).

Proximate Analysis: Table 9.1

Parameters	Content (% w/w)
Moisture	66.8%
Ash	0.58%,
FC	3.53%,
VM	29.09%,
GCV	2051 Kcal/kg,

Ultimate Analysis: Table 9.2

C	20.24%,
H_2	5.36%,
O_2	6.707%,
N_2	0.083%,
S	0.23%,
Moisture	66.8%,
Ash	0.58%,

9.3.5 Brief explanation: GHGs reduction by the proposed CDM project activity

The emission reductions from the project will directly from displacement of fossil fuels consumption based boiler (for production of steam) with environmentally sustainable resources, biomass based boiler which is renewable. These steam production results directly from the combustion of bagasse (biomass) which is a by-product of sugar cane processing. The bagasse is therefore a renewable source of energy.

The project activity leads to GHG onsite emission in the form of CO_2 released is not considered to net emission. The biomass burnt is generally replaced by re-growth as over the subsequent year. An equivalent quantity of carbon is removed from the atmosphere during this re-growth, to offset the total carbon released from combustion. Therefore long term net emission of CO_2 from burning of biomass are considered to zero Since the biomass contains negligible quantity of Sulfur, Nitrogen etc. releases of other GHGs to atmosphere are considered as negligible.

9.3.6 Estimated amount of emission reductions over the chosen crediting period:

India Glycols Limited expect the project to result in a reduction of 47276 tons of CO_2 per annum for 472760 tons of CO_2 for complete project period of 10 year.

9.4 Base line methodology:

9.4.1 Title and reference of the approved baseline methodology applied to the project activity:

Main Category:

Type I – Renewable energy power project

Sub Category:

C- Thermal energy for captive use

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

As there is no legally bound on M/S INDIA GLYCOLS LTD. to use biomass a non-conventional energy sources for steam generation for turbo turbine. M/S INDIA GLYCOLS LTD. has very cheap alternative to get steam through already installed fossil fuel fired boilers by increasing fuel load. The biomass based project activity is a voluntary step undertaken by M/S INDIA GLYCOLS LTD. with no direct or indirect mandate by law.

The main driving forces to this 'Climate change initiative, have been:

- GHG reduction and subsequent carbon financing against sale consideration of carbon credits.
- The rural development of the region by creating a new demand for the waste biomass thereby providing source of additional revenue for the bagasse generators.
- Demonstration to other entrepreneur the un -tapped potential of generating clean power from combustion of biomass

The implementation of the project activity has its associated barriers which are not faced by the alternative to continue with use of fossil fuel fired boilers for steam generation.

9.5 Barriers for project success:

9.5.1 Investment barrier:

M/S INDIA GLYCOLS LTD. was the first project proponent to utilize renewable biomass for generating steam. Some of the reason for low penetration of such renewable energy project and little willingness of entrepreneurs to invest in similar kind of project activity (use other biomass as rice-husk etc.) and change the current operating practices in the region area.

- High initial investment
- bagasse generation in M/S INDIA GLYCOLS LTD. is not sufficient fuel for complete year,
- investment on biomass gathering area near Rab unit
- Investment to purchasing biomass waste from formers or other biomass waste generators.
- Investment return rate (IRR) is very low without CER to install new multi fuels (Rice-husk & bagasse etc.) fired boiler in place of financially more viable alternative fossil fuel fired boilers for steam generation led to higher GHG emissions.
- Since there is a lot of biomass available, the success of our project will attract more investment in the region in terms of more biomass upward. In absence of CDM credit the biomass price increase may act as a driver for switching over to coal as fuel.

- Need to develop an infrastructure in terms of manpower and financial resources, in order to insure continuous sugarcane availability. This is a difficult task since one single suppliers can supply the quantity of sugarcane required for juice and biomass generation for project activity. M/S INDIA GLYCOLS LTD. has encouraged farmers of the region to go for sugarcane farming as providing them,
- Cash payment of there sugarcane at M/s India Glycols Ltd.
- Providing good quality seeds, manure in cheep rate.
- Providing technical assistance to the farmers.
- Providing guideline for bank loan.

9.5.2 Barrier due to prevailing practice:

- Prevailing practice in India for steam generation is fossil fuel based boilers have led to higher GHG emissions as well as cost of bagasse is high (it can use as raw material for pulp and paper industry).
- Renewable source of energy (bagasse etc;) is available in bulk amount.
- M/S INDIA GLYCOLS LTD. is one such entrepreneur to initiate this GHG abatement project under CDM with view of obtaining carbon finance and it will definitely encourage other Entrepreneurs to come up with similar project activities contributing further towards GHG emission reduction.

Carbon financing would significantly help M/S INDIA GLYCOLS LTD. to offset the adverse conditions discussed under above-mentioned barriers, which are faced by such project activities.

9.5.3 Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.

9.6 Definition of the project boundary:

Project boundary encompasses the physical and geographical site of the renewable generation source.

For the project activity project boundary is from sugarcane generation to steam supply for turbo turbine. Project boundary covers sugarcane storage, turbo turbine in process, bagasse storage, boiler & steam supply.

The project boundary is the place where all the activities are being done for the specific project, in this case sugar cane source, sugar cane juice extraction and bagasse separation is remain out of the boundary.

The exact position of the project boundary has been shown in the next page.

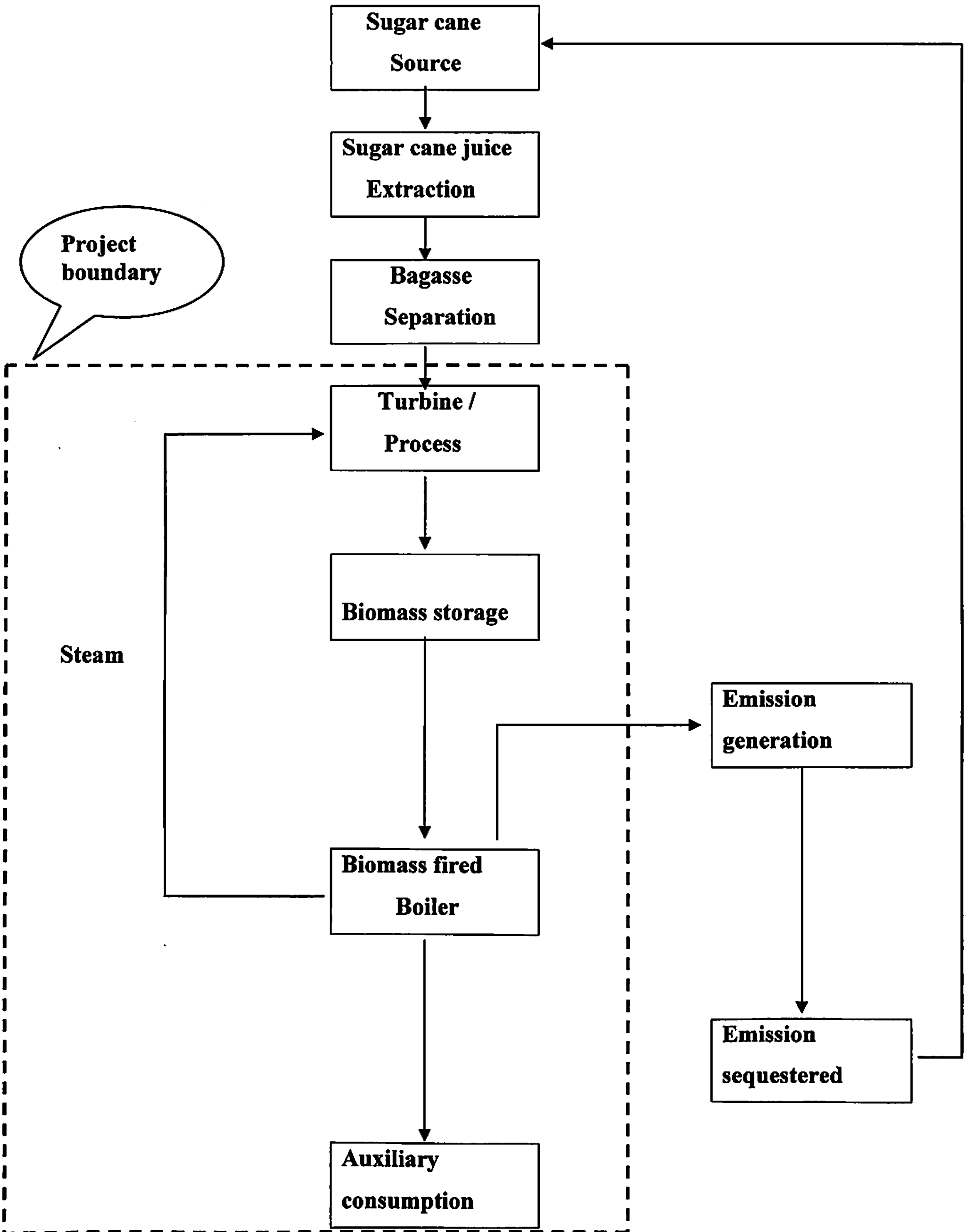


Figure: 9.1. Flow chart & Project boundary.

9.6.1 Duration of the project activity / Crediting period:

Expected operational lifetime of the project activity is 15 year.

9.6.2 Choice of the crediting period and related information:

Renewable crediting period:

a) Starting date of the first crediting Period: April 1st 2006

b) Length of the first crediting period = 10 years

9.6.3 Monitoring methodology and plan:

Monitoring shall consist of:

(a) Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient.

9.6.4 Justification of the choice of the methodology and why it is applicable to the project activity:

Generation of steam for captive consumption using biomass as fuel load to mitigation of GHG emissions from fossil fuel based steam generation. In order to monitor the mitigation of GHG due to project activity at M/S INDIA GLYCOLS LTD., metering of quantity, temperature & pressure of steam calculate the net energy produced. GHG emission will further calculate by energy produced multiplied by an emission coefficient.

9.7 Description of Monitoring Plan:

The project activity will have

9.7.1 Direct On-Site emissions:

Direct on-site emissions of the project activity arise from the combustion of biomass in the boiler. The emissions mainly include CO_2. The CO_2 released during the combustion will be consumed by the plant species for their growth. In view of the above, biomass combustion and growth of biomass and associated CO_2 consumption and release can be treated as cyclic process resulting- in no net increase of CO_2 in the atmosphere Hence, the project will not lead to GHG emissions

9.7.2 Direct off-site emission:

Direct off-site emission in the project activity arises from the transportation of biomass. The same type of GHG emissions occurs (in the absence of project activity) during transportation of diesel from petroleum refinery, to the project site. To be on conservative side CO_2 emission due to diesel

Transportation has not been considered in the baseline emissions and hence a small amount of emissions due to transportation of biomass has been neglected from the calculations.

9.7.3 Indirect On-Site emissions:

The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of biomass based boiler. Considering the life of the project activity and the emissions to be avoided in the life span, emissions from the above-mentioned source are too small and hence neglected.

No other indirect on-site emissions are anticipated from the project activity.

9.7.4 Project Parameters affecting Emission Reduction

Monitoring Approach:

The general monitoring Principles are based on:

- Frequency
- Reliability
- Registration and reporting

As the emission reduction from the project are determined by the number of units supplied to the manufacturing unit (and then multiplying with appropriate emission factor) it becomes important for the project activity to monitor the gross steam produced and auxiliary steam consumed on real time basis and calculate the net steam supplied.

- **Frequency of monitoring:**

The project developer will install all metering facilities and check them. The measurement will be monitored and recorded on a continuous basis by the project developer.

- **Reliability:**

The amount of emission reduction is proportional to the net energy (thermal) or steam generation from the project. Since the reliability of monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result. All steam parameters, quantity calibrated timely for ensuring reliability of system. All instrument carry tag plates, which indicates calibration dates.

- **Registration & Reporting:**

Daily, weekly and monthly reports will be prepared starting from the generation. The other major factors, which need to be ensured and monitored, are the use of biomass.

9.8 Metering instrument and specification for the project: (Instrumentation/ Rab unit/ Technical)

1. Pressure gauge for pressure analysis
2. Temperature gauge for temperature analysis
3. Flow meter for steam flow rate analysis
4. Calculation sheet & registered for energy calculation per day in MW
5. Quantity of biomass used.
6. Quantity of biomass purchased (Trip wise data generation sheet)and calculation of diesel required to transport the biomass every trip.
7. Ultimate analysis of biomass for in-house production & purchased
8. Some other requirement parameter for monitoring requirement
9. Calibration of each instrument used for monitoring logbook

Calibrations of the equipment will be regularly undertaken and made available at time of verification, if the DOE does not deem calibration sufficient then the meters will be re-calibrated at the time of verification and adjustments made to readings if necessary.

9.8.1 Fuel related parameters:

- Quantity of biomass used in the boiler as fuel

The biomass generated & received will be stored in the plant's storage area specially designed for such storage. The amount of biomass entering the plant will be measured and records of the same will be maintained. The weighing system would be calibrated annually to ensure the accuracy of the measurement. The data will be recorded for further verification. The amount of biomass purchased will be based on invoices receipts from fuel contractors. The amount of biomass fed to the boiler would also be verified through audit reports.

Table9.3

Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	**Uncertainty level of data (High/Medium/ Low)**	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**
D3 (a) 1	Low	This data will be used to calculate emission reduction from the project
D3 (a) 2	Low	This data will be used to calculate energy generation from the project
D3 (a) 3	Low	This data will be used to calculate energy generation from the project
D3 (a) 4	Low	This data will be used to calculate emission reduction from the project
D3 (b) 1	Low	This data will be used to supporting information to calculate emission reduction from the project
D3 (b) 2	Low	This data will be used to supporting information to calculate emission during the project as transport emission
D3 (b) 3	Low	This data will be used to supporting information to calculate emission during the project as transport emission
D3 (b) 4	Low	This data will be used to supporting information to calculate emission during the project as transport emission

9.9 Description of formulae used to estimate project emission:

The project activity leads to GHG on-site emissions in the form of CO_2 emissions from combustion of biomass. The project activity uses an environmentally renewable resource as fuel for power generation. The plantations, representing a cyclic process of carbon sequestration will consume the CO_2 emissions from biomass combustion process.

Since the biomass contains negligible quantities of other elements like Nitrogen, Sulphur etc. release of other GHG emissions are considered negligible.

GHG emissions during on-site construction work are negligible compared to GHG reductions in the project lifetime and are not accounted for. Similarly emissions associated with transportation of construction materials are ignored.

However the biomass is available in surplus in the region, and it can be safely assumed that coal will not be used in project scenario and emissions from such usage are not included. Hence the uncertainties in the project emissions are negligible. In case coal is used the CO_2 emissions during the usage of coal will be calculated in the following manner:

Tons of CO_2 = (44/12) x Percentage of total carbon in coal x Quantity of coal used in tons.

9.9.1 Description of formulae used to estimate leakage:

For Category I.C., leakage estimation is only required if renewable energy technology is equipment transferred from another activity. This does not apply to the project case. However, the only source of considerable GHG emissions, which are attributable to the project activity, lies outside the project boundary and the said emissions occur from transportation of biomass to the project site. The same has been estimated below.

9.9.2 Emission only when the biomass import to M/S INDIA GLYCOLS LTD. by diesel vehicle from local area

Emissions due to transportation of biomass is less than the emission from coal transportation

The formula and the description are given in the next page.

Emission only when the biomass import to M/S IGL by diesel vehicle from local area:

Table 9.4

Total bagasse requirement	Ton/year	At
Bagasse transported by trucks	Ton/year	Bt
Bagasse load per truck	Ton/year	Xt
Total no. of trucks		Bt/Xt
Max. distance between project site and collection centres	Km	Ct
Consumption of diesel per trip[to & fro,@ 4 km /lit]	Litres	Bt x Ct/[Xt x 4]
Total diesel consumption	Litres	Bt x Ct /[Xt x 4]
Calorific value of diesel	TJ/lit	Dt
Emission factor for diesel	tCO_2/TJ	Ed
Emission due to transportation of bagasse.	**$t\ CO_2$/year**	**Pey = [b x c /[5 x 4] x d x e.**

The same type of GHG emission occur during transportation of coal yard to IGL and therefore the emission due to transportation of bagasse is not considered in the leakage.

Similarly CO_2 generated in transporting ash from India Glycols Limited to land disposal site is not considered as almost same quantity of ash would have been generated and disposed off if the boiler were to operate on coal as the fuel.

Since category I.C does not indicate a specific formula to calculate the GHG emission reduction by source, the formula is described below:

9.9.3 Description of the formula:

- 0.8 -ton / MWh
- Calculation for energy generation in MWh from biomass fired boiler per year: 'Py' MWh / annum
- Emission reduction =0.8 x Py [Ton CO_2 / MWh x MWh / annum]
- CER =GHG emission reduction = 0.8 x P [Ton CO_2 / annum]
- Weighted average =0.8Ton CO_2 / MWh
- ERy =Emission reduction in year y MT of CO_2
- Pey = Project emission in year y
- Bey = Baseline emission reduction in year y
- ERy =Bey -Pey

Emission reduction due to bagasse fired boiler: Table 9.5

Total steam generation	T/hr	Ay
Enthalpy of steam @ T^0C temp & pressure	KJ/kg	By
Temperature of steam generated	^0C or ^0K	T
Pressure of steam generated	Kg/cm^2	P
Thermal energy generation	MJ/hr	Ay x By
No. of working day /year	Days	Dy
Working hours /day	Hr	H
Thermal power /year	Mwh per year	Py = Ay x By x Dy x H /3600
Emission factor for steam generation of **M/s IGL**	$MTCO_2/MJ$	E= 0.8
Base line emission reduction	**tCO2/year**	**Bey =E x Py**

9.9.4 CALCULATION PROCEDURE:

DESIGN CAPACITY (TEMP, PRESSURE & STEAM GENERATION BY USING BIOMASS)

Temperature of steam (^oC) =315

Pressure of steam (kgf/cm^2) =21.5

Enthalpy of steam (kJ/kg) =2519

Mass of steam generated (Ton/hr) = 45

Thermal Energy of steam (MWh) =31 Designed

PRESENT WORKING CONDITION:

Temperature of steam (^oC) = 300

Pressure of steam (kgf/cm^2) = 21.5

Enthalpy of steam (kJ/kg) = 2519

Mass of steam generated (Ton/hr) = 20

No of working day/year = 180 Days

Thermal Energy of steam = 17 MWh

P (Energy generation in MWh from biomass fired boiler per year) =59,095 MWh/annum CO_2 Emission reduced = 47276.0 Tons/year

- CERs = 47276.0 per year
- CER for complete project period (10 year) = 472760

Result:

The proposed CDM project reduces CO_2 emission by 47276 T/Annum comparison to the coal-fired boiler.

Table 9.6

Year [01 January – 31 December]	**CO_2 abated T / annum.**
2007	47276
2008	47276
2009	47276
2010	47276
2011	47276
2012	47276
2013	47276
2014	47276
2015	47276
2016	47276
Total in 10 years	**472760**

The total CO_2 emission reduction with the help of bagasse fired boiler, will be 472760 Tonnes for the proposed time duration of ten years.

Total amount in INR for credit period (10 year) =472760 x 6 x 45 =**127645200 Rs.**

Present rate = $ 6 / CER

Present conversion rate = Rs 45.

Conclusion:

Sustainable development is "Development that meets the need of the present, but without compromising the ability of future generations to meet their own needs.so the sustainable development is the only way to save our earth by the hazardous consequences of GHGs emission.and to make our earth a GREEN EARTH.

The proposed CDM project of India Glycols Limited reduces the GHGs emission.

So this type of projects should be taken by other sectors also.

Developed countries should take more interest to save our precious earth. IPCC have already warned the developed countries that the condition will be more worst in future if we will not think about it today. The sustainable development is not only the responsibility of the developing countries but also the developed countries.

As we know that the developed countries are the most responsible for today's global warming so they should also take some responsibility rather being complacent to reduce the GHGs emission.

Their responsibilities not only ends in terms of providing monitory help to the developing countries and earn the carbon numbers only.but also they should take some pathbreaking decisions, as the statistics states that developed countries (specially U.S.A. & CANADA, contributing 81%) are the highest contributor towards releasing the GHGs which has raised a serious question about the very existence of LIFE on Earth.

Now the time has come that we have to come over from conferences, committees, treaties, protocols and should take things pretty seriously to combat the problem of Global Warming and to do so we have to start thinking from an individual level and the one way to do this by moving towards renewable sources of energy like wind turbines, solar energy etc and make the utmost use of these natural sources of energy; the other way by using sensibly the existing nonrenewable sources of energy.

ANNEXURE

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	Dec. 01st 2006

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	0	0	**0**	0	0	**0.0**	0	0	0
7 AM - 8 AM	0	0	**0**	0	0	**0.0**	0	0	0
8 AM - 9 AM	28.5	58	**16.00**	20.00	310	**7.0**	3044.10	242.6	12
9 AM –10 AM	29.5	92	**21.30**	20.70	315	**9.3**	3053.70	385.17	16
10AM - 11AM	29.6	104	**18.10**	21.10	312	**7.9**	3045.70	435.76	13
11AM - 12PM	29.2	108	**22.70**	21.10	347	**9.9**	3125.70	452.66	17
12AM - 1PM	29.5	108	**25.90**	20.50	320	**11.3**	3065.60	452.7	19
1 PM – 2 PM	29.4	107	**27.20**	20.50	325	**11.8**	3077.00	448.4	20
2 PM – 3 PM	29.1	107	**22.70**	20.50	320	**9.9**	3065.60	448.4	17
3 PM – 4 PM	28.8	108	**23.90**	20.00	292	**10.4**	3002.40	452.7	17
4 PM – 5 PM	29.7	107	**21.90**	20.50	315	**9.5**	3054.20	448.4	16
5 PM – 6 PM	28.7	108	**24.20**	19.50	303	**10.5**	3029.30	452.7	17
6 PM – 7 PM	30.1	107	**20.20**	20.00	304	**8.8**	3030.30	448.4	14
7 PM – 8 PM	29.4	108	**27.40**	20.50	320	**11.9**	3065.60	452.7	20
8 PM – 9 PM	29.1	108	**18.50**	21.00	330	**8.0**	3087.20	452.7	14
9 PM – 10 PM	29.5	106	**20.90**	20.50	321	**9.1**	3067.90	444.2	15
10 PM - 11 PM	30.1	106	**24.80**	20.50	299	**10.8**	3017.30	444.2	18
11 PM - 12 AM	28.9	106	**27.30**	20.00	330	**11.9**	3089.60	444.2	20
12 AM- 1 AM	29.7	109	**17.10**	21.00	330	**7.4**	3087.20	456.9	12
1 AM - 2 AM	29.4	107	**32.90**	19.50	312	**14.3**	3049.90	448.4	24
2 AM - 3 AM	29.2	108	**13.00**	21.00	314	**5.7**	3050.60	452.7	9
3 AM - 4 AM	29.8	109	**22.60**	21.00	330	**9.8**	3087.20	456.9	17
4 AM - 5 AM	29.4	108	**22.60**	21.00	326	**9.8**	3078.10	452.7	16
5 AM - 6 AM	29.2	108	**20.00**	20.50	330	**8.7**	3088.40	452.7	15
								Total	**343**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL)	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	Dec. 02nd 2006

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	28.5	109	**23.1**	21.0	331	**10.0**	3089.5	456.89	17
7 AM - 8 AM	29.3	109	**23.8**	20.9	308	**10.3**	3037	456.89	17
8 AM - 9 AM	29.1	109	**23.1**	20.9	332	**10.0**	3092.00	456.9	17
9 AM –10 AM	29.2	109	**23.2**	21.4	306	**10.1**	3031.00	456.89	17
10AM - 11AM	29.1	109	**24.1**	21.2	322	**10.5**	3068.40	456.89	17
11AM - 12PM	29.3	109	**24.0**	21.0	324	**10.4**	3073.50	456.89	17
12AM - 1PM	30.4	108	**19.5**	21.0	290	**8.5**	2994.60	452.7	14
1 PM – 2 PM	29	109	**28.6**	21.0	328	**12.4**	3082.60	456.9	21
2 PM – 3 PM	29.8	109	**21.8**	20.5	321	**9.5**	3067.90	456.9	16
3 PM – 4 PM	29.2	108	**23.5**	21.0	317	**10.2**	3057.50	452.7	17
4 PM – 5 PM	29.3	108	**22.4**	20.0	309	**9.7**	3041.80	452.7	16
5 PM – 6 PM	28.7	106	**27.2**	21.0	306	**11.8**	3032.10	444.2	20
6 PM – 7 PM	29.8	108	**20.8**	20.5	299	**9.0**	3017.30	452.7	15
7 PM – 8 PM	29.1	107	**19.1**	20.0	318	**8.3**	3062.30	448.4	14
8 PM – 9 PM	29.4	107	**24.9**	21.0	318	**10.8**	3059.80	448.4	18
9 PM – 10 PM	29.5	108	**20.2**	21.0	314	**8.8**	3050.60	452.7	15
10 PM - 11 PM	29.13	109	**26.4**	21.6	315	**11.5**	3051.30	456.9	19
11 PM - 12 AM	29.8	108	**25.1**	21.0	334	**10.9**	3096.30	452.7	18
12 AM- 1 AM	28.4	108	**21.5**	21.0	331	**9.3**	3089.50	452.7	16
1 AM - 2 AM	30.1	107	**23.4**	21.1	314	**10.2**	3050.30	448.4	17
2 AM - 3 AM	29.5	107	**21.5**	21.0	321	**9.3**	3066.70	448.4	16
3 AM - 4 AM	29.1	106	**21.4**	21.0	320	**9.3**	3064.40	444.2	16
4 AM - 5 AM	29.2	109	**21.5**	21.1	318	**9.3**	3059.50	456.9	16
5 AM - 6 AM	29.5	109	**24.5**	21.0	320	**10.7**	3064.40	456.89	18
								Total	**401**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"
		Doc. No. — PDD- 01
	DAILY DATA MONITORING	Section — RAB UNIT
		Approved by —
		Date — Dec. 03rd 2006

	Feed Water Inlet		**Superheated steam from Boiler**			**Fuel Inlet**	**Thermal Energy generation from boiler**		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	29.4	108	**23.3**	21.0	304	**10.1**	3027.5	452.66	17
7 AM - 8 AM	29.5	109	**23.3**	20.5	330	**10.1**	3088.4	456.89	17
8 AM - 9 AM	29.1	109	**25.6**	20.7	306	**11.1**	3033.00	456.9	18
9 AM –10 AM	29.1	109	**23.0**	20.6	310	**10.0**	3042.50	456.89	17
10AM - 11AM	30.9	100	**7.2**	21.0	320	**3.1**	3064.40	418.87	5
11AM - 12PM	30.8	90	**7.0**	19.0	260	**3.0**	2928.70	376.76	5
12AM - 1PM	29.2	109	**25.2**	21.0	329	**11.0**	3084.90	456.9	18
1 PM – 2 PM	30.1	109	**24.5**	20.8	315	**10.7**	3053.40	456.9	18
2 PM – 3 PM	30.8	109	**20.8**	21.0	324	**9.0**	3073.50	456.9	15
3 PM – 4 PM	28.9	108	**24.7**	20.5	305	**10.7**	3031.20	452.6	18
4 PM – 5 PM	29.2	109	**25.2**	20.5	330	**11.0**	3088.40	456.9	18
5 PM – 6 PM	28.5	109	**26.8**	21.0	323	**11.7**	3071.20	456.9	19
6 PM – 7 PM	29.2	108	**27.5**	21.0	314	**12.0**	3050.60	452.7	20
7 PM – 8 PM	30.3	109	**24.9**	20.5	325	**10.8**	3077.00	456.9	18
8 PM – 9 PM	29.3	108	**25.2**	21.0	307	**11.0**	3034.50	452.7	18
9 PM – 10 PM	29.4	109	**24.0**	21.0	310	**10.4**	3041.40	456.9	17
10 PM - 11 PM	30.3	108	**24.5**	21.4	330	**10.7**	3086.30	452.7	18
11 PM - 12 AM	29.8	108	**23.6**	21.0	306	**10.3**	3032.10	452.7	17
12 AM- 1 AM	30.1	107	**25.1**	20.9	314	**10.9**	3050.90	448.4	18
1 AM - 2 AM	30.3	108	**23.6**	21.1	325	**10.3**	3075.60	452.7	17
2 AM - 3 AM	29.5	110	**28.4**	21.6	303	**12.3**	3023.50	461.1	20
3 AM - 4 AM	30.4	108	**25.3**	21.5	303	**11.0**	3023.80	452.7	18
4 AM - 5 AM	29.3	107	**26.8**	21.4	310	**11.7**	3040.30	448.4	19
5 AM - 6 AM	30.4	108	**24.7**	21.3	312	**10.7**	3045.20	452.7	18
								Total	**404**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	Dec. 04th 2006

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	29.1	108	**20.5**	20.6	315	**8.9**	3053.9	452.66	15
7 AM - 8 AM	29.8	109	**21.1**	21.0	310	**9.2**	3041.4	456.89	15
8 AM - 9 AM	29.2	109	**22.3**	20.9	303	**9.7**	3025.40	456.9	16
9 AM –10 AM	28.8	109	**22.9**	20.6	323	**10.0**	3072.20	456.89	17
10AM - 11AM	29.3	108	**19.7**	21.0	313	**8.6**	3048.30	452.66	14
11AM - 12PM	28.9	108	**21.5**	21.0	310	**9.3**	3041.40	452.66	15
12AM - 1PM	29.1	108	**26.8**	20.8	306	**11.7**	3032.70	452.7	19
1 PM – 2 PM	29.5	108	**26.6**	21.0	310	**11.6**	3041.40	452.7	19
2 PM – 3 PM	29.3	108	**23.2**	20.5	309	**10.1**	3040.40	452.7	17
3 PM – 4 PM	29.8	109	**26.5**	21.0	330	**11.5**	3087.20	456.9	19
4 PM – 5 PM	29.3	109	**20.8**	20.5	329	**9.0**	3086.10	456.9	15
5 PM – 6 PM	29.2	108	**22.2**	21.0	322	**9.7**	3068.90	452.7	16
6 PM – 7 PM	27.1	107	**29.0**	21.0	310	**12.6**	3041.40	448.4	21
7 PM – 8 PM	29.8	106	**19.1**	20.5	305	**8.3**	3031.20	444.2	14
8 PM – 9 PM	29.5	107	**26.7**	20.5	308	**11.6**	3038.10	448.4	19
9 PM – 10 PM	29.6	107	**21.3**	21.0	306	**9.3**	3032.10	448.4	15
10 PM - 11 PM	29.6	107	**25.1**	21.4	312	**10.9**	3044.90	448.4	18
11 PM - 12 AM	29.6	108	**24.1**	21.3	318	**10.5**	3059.00	452.7	17
12 AM- 1 AM	29.4	107	**26.1**	21.4	339	**11.3**	3106.90	448.4	19
1 AM - 2 AM	30.1	108	**24.1**	21.5	329	**10.5**	3083.70	452.7	18
2 AM - 3 AM	29.6	109	**26.9**	20.8	329	**11.7**	3085.40	456.9	20
3 AM - 4 AM	29.5	106	**24.4**	21.0	339	**10.6**	3084.90	444.2	18
4 AM - 5 AM	22.5	105	**10.4**	22.5	244	**4.5**	2871.70	440.0	7
5 AM - 6 AM						**0.0**			0
								Total	**384**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	Dec. 05th 2006

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	0	0	0	0	0	**0.0**	0	0	0
7 AM - 8 AM	0	0	0	0	0	**0.0**	0	0	0
8 AM - 9 AM	0	0	0	0	0	**0.0**	0	0	0
9 AM –10 AM	0	0	0	0	0	**0.0**	0	0	0
10AM - 11AM	31	46	**11.7**	20.0	293	**5.1**	3004.70	192.47	9
11AM - 12PM	29.8	109	**30.7**	21.0	329	**13.3**	3084.90	456.89	22
12AM - 1PM	29.9	109	**27.7**	21.0	328	**12.0**	3082.60	456.9	20
1 PM – 2 PM	30.6	108	**32.0**	21.0	324	**13.9**	3073.50	452.7	23
2 PM – 3 PM	29.4	109	**29.9**	21.0	330	**13.0**	3087.20	456.9	22
3 PM – 4 PM	29.5	108	**30.1**	21.0	329	**13.1**	3084.90	452.7	22
4 PM – 5 PM	29.2	109	**27.8**	20.5	325	**12.1**	3077.00	456.9	20
5 PM – 6 PM	29.1	108	**31.8**	21.0	308	**13.8**	3036.80	452.7	23
6 PM – 7 PM	29.3	108	**28.1**	20.0	330	**12.2**	3089.60	452.7	21
7 PM – 8 PM	29.7	108	**33.8**	20.5	325	**14.7**	3077.00	452.7	25
8 PM – 9 PM	29.8	108	**34.1**	20.5	330	**14.8**	3088.40	452.7	25
9 PM – 10 PM	29.5	105	**23.5**	21.0	305	**10.2**	3029.80	440.0	17
10 PM - 11 PM	30.4	109	**30.4**	20.4	312	**13.2**	3047.60	456.9	22
11 PM - 12 AM	30	108	**30.3**	21.2	337	**13.2**	3102.70	452.7	22
12 AM- 1 AM	29.8	108	**31.7**	20.9	313	**13.8**	3048.60	452.7	23
1 AM - 2 AM	29.9	109	**32.5**	21.7	332	**14.1**	3090.10	456.9	24
2 AM - 3 AM	30.2	106	**31.7**	21.0	309	**13.8**	3039.10	444.2	23
3 AM - 4 AM	29.4	105	**31.5**	20.8	316	**13.7**	3055.70	440.0	23
4 AM - 5 AM	29.1	107	**30.8**	20.6	314	**13.4**	3051.60	448.4	22
5 AM - 6 AM	29.2	109	**34.6**	21.7	322	**15.0**	3067.20	456.89	25
								Total	**433**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	01.01.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	28.5	106	**25.7**	21.5	310	**11.2**	3040.1	444.21	19
7 AM - 8 AM	23.4	106	**22.4**	21.7	315	**9.7**	3051.1	444.21	16
8 AM - 9 AM	22.7	106	**21.70**	21.40	298	**9.4**	3012.30	444.2	15
9 AM –10 AM	21.8	106	**20.80**	22.00	299	**9.0**	3012.90	444.21	15
10AM - 11AM	25.1	106	**24.20**	21.60	311	**10.5**	3042.10	444.21	17
11AM - 12PM	23	106	**22.00**	21.40	309	**9.6**	3038.00	444.21	16
12AM - 1PM	0	0	**0.00**	0.00	0	**0.0**			0
1 PM – 2 PM	0	0	**0.00**	0.00	0	**0.0**			0
2 PM – 3 PM	25.8	105	**24.10**	21.50	313	**10.5**	3047.00	440.0	17
3 PM – 4 PM	24.1	105	**23.40**	21.30	298	**10.2**	3012.60	440.0	17
4 PM – 5 PM	23.6	106	**22.40**	21.70	320	**9.7**	3062.60	444.2	16
5 PM – 6 PM	26.1	106	**25.30**	20.90	329	**11.0**	3085.20	444.2	19
6 PM – 7 PM	24.1	106	**23.40**	21.00	315	**10.2**	3052.90	444.2	17
7 PM – 8 PM	25	106	**23.70**	21.40	316	**10.3**	3054.20	444.2	17
8 PM – 9 PM	23.4	105	**22.10**	20.10	305	**9.6**	3032.30	440.0	16
9 PM – 10 PM	24.1	106	**23.60**	21.30	346	**10.3**	3123.00	444.2	18
10 PM - 11 PM	0	0	**0.00**	0.00	0	**0.0**			0
11 PM - 12 AM	21.9	90	**23.80**	20.00	338	**10.3**	3107.70	375.8	18
12 AM- 1 AM	21.9	106	**21.70**	20.90	310	**9.4**	3041.70	444.2	16
1 AM - 2 AM	24.9	107	**24.60**	20.90	305	**10.7**	3030.10	448.4	18
2 AM - 3 AM	27.9	107	**27.80**	20.50	325	**12.1**	3077.00	448.4	20
3 AM - 4 AM	27.8	108	**27.70**	21.00	310	**12.0**	3041.40	452.7	20
4 AM - 5 AM	25.3	107	**25.20**	21.40	324	**11.0**	3072.50	448.4	18
5 AM - 6 AM	22.7	107	**22.10**	21.00	320	**9.6**	3064.40	448.43	16
								Total	345

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL)
		Doc. No. — PDD- 01
	DAILY DATA MONITORING	Section — RAB UNIT
		Approved by —
		Date — 02.01.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	25.7	106	**24.90**	21.70	331	**10.8**	3087.8	444.21	18
7 AM - 8 AM	22.8	106	**22.20**	21.30	327	**9.7**	3079.6	444.21	16
8 AM - 9 AM	24.3	107	**23.40**	21.00	312	**10.2**	3046.00	448.4	17
9 AM –10 AM	23.9	107	**24.00**	21.20	309	**10.4**	3038.50	448.43	17
10AM - 11AM	26.8	107	**26.20**	20.90	303	**11.4**	3025.40	448.43	19
11AM - 12PM	24.6	107	**23.30**	21.60	321	**10.1**	3065.40	448.43	17
12AM - 1PM	24.8	107	**23.50**	21.30	328	**10.2**	3081.90	448.4	17
1 PM – 2 PM	25.2	107	**24.30**	21.50	320	**10.6**	3063.10	448.4	18
2 PM – 3 PM	24.1	106	**23.50**	21.30	305	**10.2**	3029.00	444.2	17
3 PM – 4 PM	23.4	106	**22.30**	21.40	313	**9.7**	3047.30	444.2	16
4 PM – 5 PM	26.1	106	**25.10**	21.00	218	**10.9**	2805.20	444.2	16
5 PM – 6 PM	21	106	**19.40**	21.30	302	**8.4**	3022.00	444.2	14
6 PM – 7 PM	27.4	106	**26.90**	21.20	320	**11.7**	3063.90	444.2	20
7 PM – 8 PM	22.3	106	**21.60**	21.40	320	**9.4**	3063.40	444.2	16
8 PM – 9 PM	26.3	106	**24.50**	21.60	318	**10.7**	3058.30	444.2	18
9 PM – 10 PM	21	106	**20.00**	21.50	317	**8.7**	3056.20	444.2	15
10 PM - 11 PM	24.3	106	**24.20**	20.80	313	**10.5**	3048.80	444.2	18
11 PM - 12 AM	26.1	105	**25.10**	21.10	315	**10.9**	3052.60	440.0	18
12 AM- 1 AM	25.2	106	**25.20**	20.70	309	**11.0**	3039.90	444.2	18
1 AM - 2 AM	24.2	106	**24.20**	20.50	305	**10.5**	3031.20	444.2	17
2 AM - 3 AM	20.3	106	**20.10**	21.50	317	**8.7**	3056.20	444.2	15
3 AM - 4 AM	29.4	106	**29.10**	21.00	309	**12.7**	3039.10	444.2	21
4 AM - 5 AM	20.1	106	**20.00**	20.50	328	**8.7**	3083.80	444.2	15
5 AM - 6 AM	23.2	106	**23.10**	20.80	302	**10.0**	3023.40	444.21	17
								Total	**408**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	03.01.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	25.5	106	**24.50**	21.50	311	**10.7**	3042.4	444.21	18
7 AM - 8 AM	25.7	106	**24.70**	21.70	300	**10.7**	3016.2	444.21	18
8 AM - 9 AM	26.8	106	**25.80**	21.40	313	**11.2**	3047.30	444.2	19
9 AM –10 AM	26.5	106	**25.50**	21.70	334	**11.1**	3094.70	444.21	19
10AM - 11AM	24.7	106	**23.70**	21.30	318	**10.3**	3059.00	444.21	17
11AM - 12PM	23.7	106	**22.80**	21.60	331	**9.9**	3088.10	444.21	17
12AM - 1PM	23.5	106	**22.50**	21.60	340	**9.8**	3108.60	444.2	17
1 PM – 2 PM	23.9	106	**22.90**	21.60	311	**10.0**	3042.10	444.2	17
2 PM – 3 PM	26.9	105	**26.30**	21.00	312	**11.4**	3046.00	440.0	19
3 PM – 4 PM	21.9	106	**21.80**	20.90	320	**9.5**	3064.60	444.2	16
4 PM – 5 PM	25.2	107	**25.80**	21.00	311	**11.2**	3043.70	448.4	19
5 PM – 6 PM	21.9	107	**21.60**	21.00	318	**9.4**	3059.80	448.4	16
6 PM – 7 PM	29.1	107	**28.70**	20.50	320	**12.5**	3065.60	448.4	21
7 PM – 8 PM	27.1	107	**26.60**	20.40	316	**11.6**	3056.70	448.4	19
8 PM – 9 PM	25.8	107	**25.20**	21.00	330	**11.0**	3087.20	448.4	18
9 PM – 10 PM	25.9	107	**25.40**	20.50	315	**11.0**	3054.20	448.4	18
10 PM - 11 PM	18.2	106	**18.10**	21.00	328	**7.9**	3082.60	444.2	13
11 PM - 12 AM	22.3	106	**22.10**	20.80	327	**9.6**	3080.80	444.2	16
12 AM- 1 AM	24.2	107	**25.70**	20.60	326	**11.2**	3079.00	448.4	19
1 AM - 2 AM	25.2	106	**24.10**	20.50	317	**10.5**	3058.80	444.2	18
2 AM - 3 AM	14.5	106	**14.00**	20.50	265	**6.1**	2935.40	444.2	10
3 AM - 4 AM	22.2	106	**22.10**	21.00	309	**9.6**	3039.10	444.2	16
4 AM - 5 AM	25.3	107	**25.20**	20.50	314	**11.0**	3051.90	448.4	18
5 AM - 6 AM	24.2	107	**24.10**	21.10	313	**10.5**	3048.00	448.43	17
								Total	**413**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	04.01.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	24.9	107	**24.30**	21.4	308	**10.6**	3035.7	448.43	17
7 AM - 8 AM	27.4	107	**26.30**	21.7	343	**11.4**	3115.3	448.43	19
8 AM - 9 AM	26.7	107	**26.10**	20.90	314	**11.3**	3050.90	448.4	19
9 AM –10 AM	20.9	107	**20.50**	21.10	313	**8.9**	3048.00	448.43	15
10AM - 11AM	26.8	106	**26.40**	21.40	315	**11.5**	3051.90	444.21	19
11AM - 12PM	27.0	107	**26.20**	20.90	312	**11.4**	3046.30	448.43	19
12AM - 1PM	28.3	106	**27.20**	20.10	300	**11.8**	3020.70	444.2	19
1 PM – 2 PM	29.1	106	**27.40**	21.50	312	**11.9**	3044.10	444.2	20
2 PM – 3 PM	24.8	107	**24.40**	21.00	314	**10.6**	3050.60	448.4	18
3 PM – 4 PM	18.9	107	**19.20**	21.00	305	**8.3**	3029.80	448.4	14
4 PM – 5 PM	24.9	107	**24.70**	21.00	301	**10.7**	3020.50	448.4	18
5 PM – 6 PM	28.4	106	**28.20**	20.90	336	**12.3**	3101.10	444.2	21
6 PM – 7 PM	21.9	106	**20.50**	20.80	312	**8.9**	3046.50	444.2	15
7 PM – 8 PM	26.0	106	**25.10**	21.00	329	**10.9**	3084.90	444.2	18
8 PM – 9 PM	28.9	107	**28.60**	20.50	328	**12.4**	3083.80	448.4	21
9 PM – 10 PM	27.6	107	**27.10**	20.50	324	**11.8**	3074.70	448.4	20
10 PM - 11 PM	22.3	106	**22.20**	20.90	317	**9.7**	3057.70	444.2	16
11 PM - 12 AM	25.2	106	**25.10**	21.00	306	**10.9**	3032.10	444.2	18
12 AM- 1 AM	30.2	107	**30.00**	20.80	338	**13.0**	3105.90	448.4	22
1 AM - 2 AM	20.3	107	**20.20**	20.90	324	**8.8**	3073.80	448.4	15
2 AM - 3 AM	26.2	107	**25.40**	21.00	330	**11.0**	3087.20	448.4	19
3 AM - 4 AM	25.2	107	**26.20**	20.80	321	**11.4**	3067.20	448.4	19
4 AM - 5 AM	24.1	107	**23.20**	20.40	315	**10.1**	3054.50	448.4	17
5 AM - 6 AM	23.2	107	**23.10**	20.70	311	**10.0**	3044.50	448.43	17
								Total	434

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	05.01.07

	Feed Water Inlet		**Superheated steam from Boiler**			**Fuel Inlet**	**Thermal Energy generation from boiler**		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	25.0	106	**23.30**	21.10	320	**10.1**	3064.1	444.21	17
7 AM - 8 AM	30.1	106	**28.50**	21.00	344	**12.4**	3119.1	444.21	21
8 AM - 9 AM	24.2	106	**23.60**	21.60	323	**10.3**	3069.7	444.21	17
9 AM –10 AM	27.9	106	**26.90**	21.40	302	**11.7**	3021.7	444.21	19
10AM - 11AM	26.3	106	**25.40**	21.50	313	**11.0**	3047.00	444.21	18
11AM - 12PM	26.9	106	**26.30**	21.40	309	**11.4**	3038.00	444.21	19
12AM - 1PM	22.6	106	**22.30**	21.70	312	**9.7**	3044.10	444.2	16
1 PM – 2 PM	29.4	106	**28.60**	21.10	327	**12.4**	3080.10	444.2	21
2 PM – 3 PM	22.5	106	**22.40**	21.00	312	**9.7**	3046.00	444.2	16
3 PM – 4 PM	27.1	106	**26.90**	20.90	312	**11.7**	3046.30	444.2	19
4 PM – 5 PM	24.9	107	**24.40**	20.80	324	**10.6**	3074.00	448.4	18
5 PM – 6 PM	26.8	107	**26.90**	21.00	326	**11.7**	3078.10	448.4	20
6 PM – 7 PM	23.7	107	**24.20**	20.90	329	**10.5**	3085.20	448.4	18
7 PM – 8 PM	18.5	107	**20.00**	21.00	323	**8.7**	3071.20	448.4	15
8 PM – 9 PM	26.4	107	**26.40**	21.00	314	**11.5**	3050.60	448.4	19
9 PM – 10 PM	26.4	107	**25.20**	21.00	321	**11.0**	3066.70	448.4	18
10 PM - 11 PM	27.2	106	**21.10**	20.90	325	**9.2**	3076.00	444.2	15
11 PM - 12 AM	21.3	106	**21.20**	21.10	328	**9.2**	3082.40	444.2	16
12 AM- 1 AM	28.1	106	**28.00**	20.80	324	**12.2**	3074.00	444.2	20
1 AM - 2 AM	25.4	106	**25.30**	21.00	319	**11.0**	3062.10	444.2	18
2 AM - 3 AM	32.0	105	**31.20**	20.20	317	**13.6**	3059.50	440.0	23
3 AM - 4 AM	25.9	106	**25.00**	20.40	320	**10.9**	3065.90	444.2	18
4 AM - 5 AM	15.2	105	**15.10**	21.00	300	**6.6**	3018.20	440.0	11
5 AM - 6 AM	19.0	104	**18.00**	20.50	258	**7.8**	2917.70	435.76	12
								Total	**426**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	01.02.07

	Feed Water Inlet		**Superheated steam from Boiler**			**Fuel Inlet**	**Thermal Energy generation from boiler**		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	24	107	**26**	21	300	**11.3**	3018.2	448.43	19
7 AM - 8 AM	25	107	**24**	21	332	**10.4**	3091.8	448.43	18
8 AM - 9 AM	22	107	**22.00**	20.80	309	**9.6**	3039.60	448.4	16
9 AM –10 AM	24	107	**25.00**	20.80	315	**10.9**	3053.40	448.43	18
10AM - 11AM	22	107	**21.00**	20.80	300	**9.1**	3018.70	448.43	15
11AM - 12PM	26	107	**22.00**	21.00	301	**9.6**	3020.50	448.43	16
12AM - 1PM	22	107	**22.00**	21.00	300	**9.6**	3018.20	448.4	16
1 PM – 2 PM	24	107	**24.00**	21.00	307	**10.4**	3034.50	448.4	17
2 PM – 3 PM	21.3	106	**21.20**	20.30	278	**9.2**	2968.10	444.2	15
3 PM – 4 PM	25.4	106	**26.00**	20.00	288	**11.3**	2993.00	444.2	18
4 PM – 5 PM	24.2	106	**24.00**	21.30	309	**10.4**	3038.30	444.2	17
5 PM – 6 PM	20.4	107	**20.10**	20.30	320	**8.7**	3066.10	448.4	15
6 PM – 7 PM	22.1	107	**22.00**	20.20	305	**9.6**	3032.30	448.4	16
7 PM – 8 PM	22.9	107	**22.30**	20.30	312	**9.7**	3047.80	448.4	16
8 PM – 9 PM	24.3	106	**24.00**	20.40	307	**10.4**	3036.10	444.2	17
9 PM – 10 PM	23.3	107	**23.90**	20.80	308	**10.4**	3037.30	448.4	17
10 PM - 11 PM	25.2	107	**25.00**	21.00	309	**10.9**	3039.10	448.4	18
11 PM - 12 AM	21.3	107	**21.20**	20.80	314	**9.2**	3051.10	448.4	15
12 AM- 1 AM	26.5	106	**26.20**	21.30	301	**11.4**	3019.70	444.2	19
1 AM - 2 AM	23.2	106	**23.10**	21.20	302	**10.0**	3022.30	444.2	17
2 AM - 3 AM	22.5	106	**22.40**	20.40	300	**9.7**	3019.90	444.2	16
3 AM - 4 AM	26.1	106	**26.00**	21.00	294	**11.3**	3004.10	444.2	18
4 AM - 5 AM	19.2	105	**19.10**	20.50	307	**8.3**	3035.80	440.0	14
5 AM - 6 AM	23.1	106	**23.00**	20.80	308	**10.0**	3037.30	444.21	17
								Total	**382**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL)	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	02.02.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	23.3	106	**23.40**	21.00	324	**10.2**	3073.5	444.21	17
7 AM - 8 AM	23	106	**23.00**	21.00	296	**10.0**	3008.8	444.21	16
8 AM - 9 AM	24	107	**24.00**	20.50	331	**10.4**	3090.70	448.4	18
9 AM –10 AM	24	105	**23.00**	21.20	315	**10.0**	3052.40	439.98	17
10AM - 11AM	23	107	**23.00**	21.00	306	**10.0**	3032.10	448.43	17
11AM - 12PM	25	107	**25.00**	20.70	308	**10.9**	3037.60	448.43	18
12AM - 1PM	27	107	**26.00**	21.00	300	**11.3**	3018.20	448.4	19
1 PM – 2 PM	21	107	**22.00**	21.00	307	**9.6**	3034.53	448.4	16
2 PM – 3 PM	25	107	**25.00**	21.00	302	**10.9**	3022.80	448.4	18
3 PM – 4 PM	24	107	**24.00**	20.50	301	**10.4**	3021.90	448.4	17
4 PM – 5 PM	22	106	**22.00**	20.50	312	**9.6**	3047.30	444.2	16
5 PM – 6 PM	26	106	**26.00**	21.50	327	**11.3**	3079.20	444.2	19
6 PM – 7 PM	24	107	**23.00**	21.00	308	**10.0**	3036.80	448.4	17
7 PM – 8 PM	22	107	**22.00**	20.90	327	**9.6**	3080.60	448.4	16
8 PM – 9 PM	26	107	**28.00**	20.30	300	**12.2**	3020.30	448.4	20
9 PM – 10 PM	25	107	**24.00**	20.70	320	**10.4**	3065.10	448.4	17
10 PM - 11 PM	21.3	107	**21.20**	21.00	304	**9.2**	3027.50	448.4	15
11 PM - 12 AM	24.8	107	**25.00**	20.50	305	**10.9**	3031.20	448.4	18
12 AM- 1 AM	30.2	106	**27.20**	20.00	300	**11.8**	3021.00	444.2	19
1 AM - 2 AM	20.8	106	**22.60**	20.80	317	**9.8**	3058.00	444.2	16
2 AM - 3 AM	22.2	107	**22.00**	20.00	310	**9.6**	3044.10	448.4	16
3 AM - 4 AM	25.6	107	**25.20**	20.70	305	**11.0**	3030.60	448.4	18
4 AM - 5 AM	31.9	106	**31.80**	20.70	300	**13.8**	3019.00	444.2	23
5 AM - 6 AM	15.9	106	**15.80**	21.00	299	**6.9**	3015.80	444.21	11
								Total	414

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	03.02.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	32	106	**29.00**	21.00	326	**12.6**	3078.1	444.21	21
7 AM - 8 AM	26	107	**26.00**	20.90	314	**gy generati**	3050.9	448.43	19
8 AM - 9 AM	27	107	**27.00**	20.80	300	**11.7**	3018.70	448.4	19
9 AM –10 AM	23	107	**23.00**	21.00	310	**10.0**	3041.40	448.43	17
10AM - 11AM	22	107	**22.00**	20.80	305	**9.6**	3030.40	448.43	16
11AM - 12PM	23.5	107	**23.60**	21.00	308	**10.3**	3036.80	448.43	17
12AM - 1PM	23.4	107	**24.20**	20.30	305	**10.5**	3031.70	448.4	17
1 PM – 2 PM	25	107	**25.00**	21.00	305	**10.9**	3029.80	448.4	18
2 PM – 3 PM	24	106	**23.10**	20.50	294	**10.0**	3005.60	444.2	16
3 PM – 4 PM	18.1	106	**19.00**	21.00	317	**8.3**	3057.50	444.2	14
4 PM – 5 PM	23	106	**22.20**	20.40	312	**9.7**	3047.60	444.2	16
5 PM – 6 PM	23	105	**22.30**	21.80	308	**9.7**	3034.60	440.0	16
6 PM – 7 PM	23.2	105	**23.00**	20.20	310	**10.0**	3043.50	440.0	17
7 PM – 8 PM	22.9	106	**23.50**	20.90	299	**10.2**	3016.10	444.2	17
8 PM – 9 PM	20.1	106	**20.50**	21.20	318	**8.9**	3059.30	444.2	15
9 PM – 10 PM	25	106	**24.80**	21.00	306	**10.8**	3032.10	444.2	18
10 PM - 11 PM	30.5	107	**30.00**	21.40	312	**13.0**	3044.90	448.4	22
11 PM - 12 AM	22.5	107	**22.10**	21.50	300	**9.6**	3016.70	448.4	16
12 AM- 1 AM	22	106	**21.80**	20.50	339	**9.5**	3108.80	444.2	16
1 AM - 2 AM	23.5	106	**28.00**	21.80	323	**12.2**	3069.30	444.2	20
2 AM - 3 AM	23	106	**22.50**	21.20	307	**9.8**	3033.90	444.2	16
3 AM - 4 AM	23	106	**22.70**	21.50	314	**9.9**	3049.30	444.2	16
4 AM - 5 AM	25	106	**24.80**	21.40	300	**10.8**	3017.00	444.2	18
5 AM - 6 AM	20.5	106	**20.00**	21.20	307	**8.7**	3033.90	444.21	14
								Total	**411**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	04.02.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	26	107	**26.00**	21.00	324	**11.3**	3073.5	448.43	19
7 AM - 8 AM	23	107	**24.00**	20.90	301	**10.4**	3020.8	448.43	17
8 AM - 9 AM	24	107	**23.00**	20.90	306	**10.0**	3032.40	448.4	17
9 AM –10 AM	24	107	**23.00**	21.00	325	**10.0**	3075.80	448.43	17
10AM - 11AM	21	107	**20.00**	20.50	289	**8.7**	2993.80	448.43	14
11AM - 12PM	22	107	**22.00**	20.90	300	**9.6**	3018.50	448.43	16
12AM - 1PM	20	107	**21.00**	20.00	323	**9.1**	3073.70	448.4	15
1 PM – 2 PM	24	107	**23.00**	21.00	333	**10.0**	3094.00	448.4	17
2 PM – 3 PM	15.3	105	**15.20**	21.20	308	**6.6**	3036.20	440.0	11
3 PM – 4 PM	24.1	107	**24.00**	20.70	313	**10.4**	3049.10	448.4	17
4 PM – 5 PM	25	106	**24.30**	20.60	315	**10.6**	3053.90	444.2	18
5 PM – 6 PM	20.8	106	**21.00**	20.80	318	**9.1**	3060.30	444.2	15
6 PM – 7 PM	26.2	107	**26.00**	21.00	286	**11.3**	2985.10	448.4	18
7 PM – 8 PM	23.2	107	**19.00**	20.90	306	**8.3**	3032.40	448.4	14
8 PM – 9 PM	21.1	107	**23.00**	20.70	319	**10.0**	3062.80	448.4	17
9 PM – 10 PM	20.5	107	**21.00**	21.00	314	**9.1**	3050.60	448.4	15
10 PM - 11 PM	24	106	**20.00**	21.40	314	**8.7**	3049.60	444.2	14
11 PM - 12 AM	24	106	**23.60**	21.20	311	**10.3**	3043.20	444.2	17
12 AM- 1 AM	22	106	**23.20**	21.80	304	**10.1**	3025.30	444.2	17
1 AM - 2 AM	22	106	**21.90**	21.00	300	**9.5**	3018.20	444.2	16
2 AM - 3 AM	19	106	**22.00**	21.10	304	**9.6**	3027.20	444.2	16
3 AM - 4 AM	24.5	107	**21.20**	21.90	304	**9.2**	3025.00	448.4	15
4 AM - 5 AM	22	107	**24.10**	20.00	330	**10.5**	3089.60	448.4	18
5 AM - 6 AM	22	106	**21.80**	21.70	302	**9.5**	3020.90	444.21	16
								Total	**385**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	05.02.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	25.0	107	**24.00**	21.00	314	**10.4**	3050.6	448.43	17
7 AM - 8 AM	26.0	107	**25.00**	21.00	310	**10.9**	3041.4	448.43	18
8 AM - 9 AM	28.0	107	**28.00**	20.50	304	**12.2**	3028.9	448.43	20
9 AM –10 AM	26.0	107	**26.00**	20.90	315	**11.3**	3053.2	448.43	19
10AM - 11AM	24.0	107	**23.00**	21.00	315	**10.0**	3052.90	448.43	17
11AM - 12PM	25.0	106	**25.00**	20.50	330	**10.9**	3088.40	444.21	18
12AM - 1PM	22.0	107	**22.00**	21.00	324	**9.6**	3073.50	448.4	16
1 PM – 2 PM	25.0	107	**25.00**	20.80	300	**10.9**	3018.70	448.4	18
2 PM – 3 PM	20.0	106	**19.00**	20.50	279	**8.3**	2969.80	444.2	13
3 PM – 4 PM	26.2	106	**26.10**	20.80	291	**11.3**	2997.60	444.2	19
4 PM – 5 PM	20.9	106	**21.60**	20.70	285	**9.4**	2983.60	444.2	15
5 PM – 6 PM	22.6	107	**20.10**	21.00	320	**8.7**	3064.40	448.4	15
6 PM – 7 PM	28.1	107	**28.00**	20.80	302	**12.2**	3023.40	448.4	20
7 PM – 8 PM	20.2	107	**20.00**	21.00	330	**8.7**	3087.20	448.4	15
8 PM – 9 PM	24.2	107	**24.10**	20.80	316	**10.5**	3055.70	448.4	17
9 PM – 10 PM	20.1	107	**20.00**	21.00	305	**8.7**	3029.80	448.4	14
10 PM - 11 PM	23	106	**22.80**	20.90	300	**9.9**	3018.50	444.2	16
11 PM - 12 AM	26	106	**25.90**	21.00	310	**11.3**	3041.40	444.2	19
12 AM- 1 AM	24.1	106	**23.70**	21.00	319	**10.3**	3062.10	444.2	17
1 AM - 2 AM	20.5	106	**20.10**	21.30	320	**8.7**	3063.60	444.2	15
2 AM - 3 AM	20.2	106	**20.20**	20.80	331	**8.8**	3089.90	444.2	15
3 AM - 4 AM	24.2	107	**24.10**	21.70	334	**10.5**	3094.70	448.4	18
4 AM - 5 AM	24.1	106	**24.00**	21.60	329	**10.4**	3083.50	444.2	18
5 AM - 6 AM	23.3	106	**23.10**	21.00	317	**10.0**	3057.50	444.21	17
								Total	405

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	01.03.07

	Feed Water Inlet		**Superheated steam from Boiler**			**Fuel Inlet**	**Thermal Energy generation from boiler**		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	35.0	107	**33.00**	21.50	331	**14.3**	3088.3	448.43	24
7 AM - 8 AM	37.0	107	**36.00**	21.00	335	**15.7**	3098.6	448.43	27
8 AM - 9 AM	32.0	100	**29.00**	21.00	296	**12.6**	3008.80	418.9	21
9 AM –10 AM	11.0	57	**11.00**	21.50	298	**4.8**	3012.00	238.45	8
10AM - 11AM	14.0	51	**12.00**	19.50	272	**5.2**	2956.30	213.37	9
11AM - 12PM	11.0	36	**12.00**	21.00	283	**5.2**	2977.80	150.69	9
12AM - 1PM	12.0	33	**11.00**	18.50	261	**4.8**	2933.10	138.2	9
1 PM – 2 PM	11.0	34	**12.00**	21.80	278	**5.2**	2963.00	142.3	9
2 PM – 3 PM	19.0	36	**18.00**	21.50	329	**7.8**	3083.70	150.7	15
3 PM – 4 PM	34.0	107	**35.00**	21.00	338	**15.2**	3105.40	448.4	26
4 PM – 5 PM	35.0	107	**33.00**	21.50	344	**14.3**	3118.00	448.4	24
5 PM – 6 PM	35.0	107	**33.00**	20.50	335	**14.3**	3099.70	448.4	24
6 PM – 7 PM	38.0	107	**34.00**	20.50	331	**14.8**	3090.70	448.4	25
7 PM – 8 PM	39.0	107	**38.00**	21.50	318	**16.5**	3058.50	448.4	28
8 PM – 9 PM	22.0	107	**19.00**	21.70	339	**8.3**	3106.10	448.4	14
9 PM – 10 PM	15.0	107	**15.00**	21.00	324	**6.5**	3073.50	448.4	11
10 PM - 11 PM	25.0	95	**23.00**	20.00	342	**10.0**	3116.70	397.8	17
11 PM - 12 AM	36.6	94	**37.00**	21.00	338	**16.1**	3105.40	393.6	28
12 AM- 1 AM	37.6	107	**33.00**	21.00	332	**14.3**	3091.80	448.4	24
1 AM - 2 AM	36.6	107	**34.00**	21.00	328	**14.8**	3082.60	448.4	25
2 AM - 3 AM	36.0	107	**35.00**	20.50	329	**15.2**	3086.10	448.4	26
3 AM - 4 AM	36.0	107	**35.00**	21.00	330	**15.2**	3087.20	448.4	26
4 AM - 5 AM	35.0	107	**33.00**	20.00	327	**14.3**	3082.80	448.4	24
5 AM - 6 AM	37.0	107	**38.00**	21.00	337	**16.5**	3103.20	448.43	28
								Total	**453**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL)	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	02.03.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	35.0	106	**30.00**	20.50	307	**13.0**	3035.8	444.21	22
7 AM - 8 AM	31.0	105	**29.00**	20.00	338	**12.6**	3107.7	439.98	21
8 AM - 9 AM	41.0	104	**38.00**	21.00	329	**16.5**	3084.90	435.8	28
9 AM –10 AM	29.0	106	**26.00**	21.50	335	**11.3**	3097.40	444.21	19
10AM - 11AM	35.0	106	**34.00**	20.00	322	**14.8**	3071.40	444.21	25
11AM - 12PM	34.0	107	**33.00**	21.00	330	**14.3**	3087.20	448.43	24
12AM - 1PM	36.0	107	**34.00**	19.50	332	**14.8**	3095.30	448.4	25
1 PM – 2 PM	37.0	106	**36.00**	21.00	330	**15.7**	3087.20	444.2	26
2 PM – 3 PM	38.0	106	**36.00**	21.50	339	**15.7**	3106.60	444.2	27
3 PM – 4 PM	37.0	106	**36.00**	21.00	344	**15.7**	3119.10	444.2	27
4 PM – 5 PM	34.0	106	**32.00**	20.50	341	**13.9**	3113.40	444.2	24
5 PM – 6 PM	38.0	106	**36.00**	20.70	317	**15.7**	3058.30	444.2	26
6 PM – 7 PM	41.0	107	**38.00**	21.50	322	**16.5**	3067.70	448.4	28
7 PM – 8 PM	32.0	107	**31.00**	20.00	328	**13.5**	3085.00	48.4	26
8 PM – 9 PM	36.0	106	**35.00**	20.50	311	**15.2**	3045.00	444.2	25
9 PM – 10 PM	33.0	106	**33.00**	21.00	323	**14.3**	3071.20	444.2	24
10 PM - 11 PM	42.0	107	**38.00**	21.00	317	**16.5**	3060.00	448.4	28
11 PM - 12 AM	34.0	107	**34.00**	21.00	326	**14.8**	3078.10	448.4	25
12 AM- 1 AM	39.0	107	**38.00**	21.00	333	**16.5**	3094.00	448.4	28
1 AM - 2 AM	34.0	107	**32.00**	20.00	333	**13.9**	3096.40	448.4	24
2 AM - 3 AM	38.0	107	**36.00**	20.40	338	**15.7**	3106.80	448.4	27
3 AM - 4 AM	39.0	107	**39.00**	19.00	327	**17.0**	3085.10	448.4	29
4 AM - 5 AM	33.0	107	**31.00**	20.00	337	**13.5**	3105.40	448.4	23
5 AM - 6 AM	38.0	107	**36.00**	21.00	338	**15.7**	3105.40	448.43	27
								Total	**606**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"
		Doc. No. — PDD- 01
	DAILY DATA MONITORING	Section — RAB UNIT
		Approved by —
		Date — 03.03.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	36.0	107	**36.00**	21.50	336	**15.7**	3099.7	448.43	27
7 AM - 8 AM	40.0	105	**38.00**	21.00	340	**16.5**	3110	439.98	28
8 AM - 9 AM	37.0	106	**36.00**	21.50	331	**15.7**	3088.30	444.2	26
9 AM –10 AM	36.0	106	**35.00**	20.50	334	**15.2**	3097.50	444.21	26
10AM - 11AM	40.0	106	**37.00**	20.00	320	**16.1**	3066.90	444.21	27
11AM - 12PM	30.0	100	**27.00**	19.00	215	**11.7**	2808.50	418.87	18
12AM - 1PM	0.0	0	**0.00**	0.00	0	**0.0**			0
1 PM – 2 PM	0.0	0	**0.00**	0.00	0	**0.0**			0
2 PM – 3 PM	0.0	71	**0.00**	20.50	325	**0.0**	3077.00	297.0	0
3 PM – 4 PM	25.0	106	**24.00**	21.80	330	**10.4**	3085.30	444.2	18
4 PM – 5 PM	33.0	107	**31.00**	21.00	318	**13.5**	3059.80	448.4	22
5 PM – 6 PM	32.0	107	**30.00**	21.30	329	**13.0**	3084.20	448.4	22
6 PM – 7 PM	34.0	107	**33.00**	21.80	330	**14.3**	3085.30	448.4	24
7 PM – 8 PM	36.0	107	**34.00**	20.80	326	**14.8**	3078.60	448.4	25
8 PM – 9 PM	34.0	107	**31.00**	21.70	330	**13.5**	3085.50	448.4	23
9 PM – 10 PM	28.0	107	**28.00**	21.00	311	**12.2**	3043.70	448.4	20
10 PM - 11 PM	35.0	107	**33.00**	21.00	335	**14.3**	3098.60	448.4	24
11 PM - 12 AM	36.0	107	**34.00**	20.00	318	**14.8**	3062.30	448.4	25
12 AM- 1 AM	37.0	107	**35.00**	21.00	325	**15.2**	3075.80	448.4	26
1 AM - 2 AM	36.0	107	**35.00**	21.00	329	**15.2**	3084.90	448.4	26
2 AM - 3 AM	35.0	107	**33.00**	20.50	331	**14.3**	3090.70	448.4	24
3 AM - 4 AM	27.0	105	**25.00**	21.00	315	**10.9**	3052.90	440.0	18
4 AM - 5 AM	28.0	106	**27.00**	21.00	319	**11.7**	3062.10	444.2	20
5 AM - 6 AM	32.0	106	**30.00**	21.00	317	**13.0**	3057.50	444.21	22
								Total	**490**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	04.03.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	32.0	107	**30.00**	21.00	324	**13.0**	3073.5	448.43	22
7 AM - 8 AM	33.0	107	**31.00**	21.00	339	**13.5**	3107.7	448.43	23
8 AM - 9 AM	34.0	107	**32.00**	20.50	340	**13.9**	3111.10	448.4	24
9 AM –10 AM	36.0	107	**34.00**	20.80	321	**14.8**	3067.20	448.43	25
10AM - 11AM	36.0	107	**35.00**	21.00	341	**15.2**	3112.30	448.43	26
11AM - 12PM	32.0	107	**30.00**	21.00	340	**13.0**	3110.00	448.43	22
12AM - 1PM	40.0	107	**38.00**	21.00	322	**16.5**	3068.90	448.4	28
1 PM – 2 PM	31.0	106	**31.00**	20.50	335	**13.5**	3099.70	444.2	23
2 PM – 3 PM	34.0	106	**31.00**	21.50	327	**13.5**	3079.20	444.2	23
3 PM – 4 PM	34.0	106	**32.00**	20.50	333	**13.9**	3095.20	444.2	24
4 PM – 5 PM	37.0	106	**35.00**	21.00	347	**15.2**	3126.00	444.2	26
5 PM – 6 PM	34.0	107	**32.00**	21.50	299	**13.9**	3014.40	448.4	23
6 PM – 7 PM	35.0	106	**33.00**	21.00	315	**14.3**	3052.90	444.2	24
7 PM – 8 PM	36.0	107	**34.00**	21.20	319	**14.8**	3061.60	448.4	25
8 PM – 9 PM	34.0	107	**34.00**	21.40	325	**14.8**	3074.80	448.4	25
9 PM – 10 PM	34.0	107	**34.00**	21.30	310	**14.8**	3040.60	448.4	24
10 PM - 11 PM	34.0	107	**31.00**	21.20	330	**13.5**	3086.70	448.4	23
11 PM - 12 AM	37.0	107	**36.00**	21.40	332	**15.7**	3090.80	448.4	26
12 AM- 1 AM	37.0	107	**36.00**	21.00	330	**15.2**	3087.20	448.4	26
1 AM - 2 AM	37.0	107	**35.00**	21.60	336	**14.8**	3099.50	448.4	25
2 AM - 3 AM	37.0	107	**34.00**	21.40	335	**14.3**	3097.70	448.4	24
3 AM - 4 AM	34.0	107	**33.00**	21.00	324	**14.8**	3073.50	448.4	25
4 AM - 5 AM	35.0	106	**34.00**	20.00	330	**14.8**	3089.60	444.2	25
5 AM - 6 AM	35.0	107	**34.00**	20.00	328	**14.8**	3085.00	448.43	0
								Total	**559**

	INDIA GLYCOLS LIMITED	Small-scale biomass fired boiler based energy generation project at M/s India Glycols Ltd.(IGL) Kashipur, Uttaranchal., India"	
		Doc. No.	PDD- 01
	DAILY DATA MONITORING	Section	RAB UNIT
		Approved by	
		Date	05.03.07

	Feed Water Inlet		Superheated steam from Boiler			Fuel Inlet	Thermal Energy generation from boiler		
Frequency (Hourly)	Feed Water Quantity (M3/hr.)	Temp. (Deg. C)	Steam Quantity (Ton/Hr)	Steam Pressure (Kgf/cm2)	Steam Temp. (Drg. C)	Fuel (****) Quantity (MT/Hr.)	Enthalpy of steam @ given Temp & Pressure (KJ/kg)	Enthalpy of feed water @ given Temp & Pressure (KJ/kg)	Energy generation (MWh)
6 AM - 7 AM	36.0	107	**35.00**	21.00	330	**15.2**	3087.2	448.43	26
7 AM - 8 AM	28.9	106	**28.50**	21.00	336	**12.4**	3100.9	444.21	21
8 AM - 9 AM	33.0	107	**28.50**	21.00	335	**12.4**	3098.6	448.43	21
9 AM –10 AM	35.0	107	**34.00**	20.50	330	**14.8**	3088.4	448.43	25
10AM - 11AM	36.0	106	**35.00**	21.00	332	**15.2**	3091.80	444.21	26
11AM - 12PM	35.0	106	**34.00**	21.50	331	**14.8**	3088.30	444.21	25
12AM - 1PM	35.0	107	**34.00**	21.80	326	**14.8**	3076.10	448.4	25
1 PM – 2 PM	35.0	107	**32.00**	21.00	329	**13.9**	3084.90	448.4	23
2 PM – 3 PM	39.0	107	**38.00**	21.50	310	**16.5**	3040.10	448.4	27
3 PM – 4 PM	34.0	106	**33.00**	21.00	322	**14.3**	3068.90	444.2	24
4 PM – 5 PM	34.0	107	**31.00**	21.00	344	**13.5**	3119.10	448.4	23
5 PM – 6 PM	35.0	106	**33.00**	20.50	316	**14.3**	3056.50	444.2	24
6 PM – 7 PM	38.0	107	**32.00**	20.00	320	**13.9**	3066.90	448.4	23
7 PM – 8 PM	40.0	107	**34.00**	21.00	333	**14.8**	3094.00	448.4	25
8 PM – 9 PM	38.0	105	**36.00**	21.00	337	**15.7**	3103.20	440.0	27
9 PM – 10 PM	30.0	106	**30.00**	21.50	331	**13.0**	3088.30	444.2	22
10 PM - 11 PM	35.0	107	**33.00**	20.50	332	**14.3**	3092.90	448.4	24
11 PM - 12 AM	35.0	106	**33.00**	21.00	330	**14.3**	3087.20	444.2	24
12 AM- 1 AM	37.0	107	**34.00**	21.50	337	**14.8**	3102.00	448.4	25
1 AM - 2 AM	36.0	107	**33.00**	20.50	329	**14.3**	3086.10	448.4	24
2 AM - 3 AM	39.0	107	**39.00**	21.50	339	**17.0**	3106.60	448.4	29
3 AM - 4 AM	34.0	107	**32.00**	21.50	333	**13.9**	3092.90	448.4	24
4 AM - 5 AM	33.0	106	**31.00**	20.00	341	**13.5**	3114.50	444.2	23
5 AM - 6 AM	33.0	107	**32.00**	21.50	339	**13.9**	3106.60	448.43	24
								Total	**583**

References:

- Clean Development Mechanism "Performance & Potential" by Michael Wara.
- The CDM Regulations-Raymond Joyce.
- CDM Regulation Procedures.
- Wikipedia.