DETAILED PROJECT REPORT
ON
METHANE CAPTURE (BY ANAEROBIC TREATMENT OF 1000 M³ /HR EFFLUENT) TECHNOLOGY
(GUJARAT DAIRY CLUSTER)










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Bureau of Energy Efficiency

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METHANE CAPTURE (BY ANAEROBIC TREATMENT OF 1000 M^3 /HR EFFLUENT) TECHNOLOGY

GUJARAT DAIRY CLUSTER

BEE, 2010

Detailed Project Report on Methane Capture (By Anaerobic Treatment Of 1000 M³ /Hr Effluent) Technology
Gujarat Dairy Cluster, Gujarat (India)
New Delhi: Bureau of Energy Efficiency;
Detail Project Report No.: ***GUJ/DRY/MCP/07***

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Petroleum Conservation Research Association

Ahmedabad

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List of Abbreviation

BEE	Bureau of Energy Efficiency
CDM	Clean Development Mechanism
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
DSH	De-super Heater
GHG	Green House Gases
IRR	Internal Rate of Return
MT	Million Tonne
MW	Mega Watt
NPV	Net Present Value
ROI	Return on Investment
SCM	Standard Cubic Meter
SIDB	Small Industrial Development Bank of India
MoMSME	Ministry of Micro Small and Medium Enterprises
WHR	Waste Heat Recovery

EXECUTIVE SUMMARY

Petroleum Conservation & Research Association (PCRA) is executing BEE-SME program in Gujarat Dairy Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Gujarat Dairy cluster is one of the very important clusters in India. Gujarat is 5th largest milk producer state in India. This explains the importance of dairy cluster in Gujarat State. Accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures/technological upgradation, so as to facilitate maximum replication in other dairy clusters in India. The main energy forms used in the cluster units are grid electricity, Natural gas and small quantity of diesel oil.

The cluster comprises of mainly two type of dairy activity viz Milk chilling center & main dairy. In milk chilling center energy is mainly consumed for milk chilling process while in dairy the major consumer of energy is various milk processes. The cluster comprises of about 80% milk chilling center & 20% dairies. In a typical milk chilling center, cost wise 61% electrical energy & 39% thermal energy being consumed.

This DPR highlights the details of the study conducted for the use of Methane Capture technology to generate bio mass for various usages, possible Energy saving and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S.No	*Particular*	*Unit*	*Value*
1	Project cost	(Rs. in Lakh)	247.56
2	Expected Electricity Savings	kWh/annum	54000
3	FO Saving details	Kg/Annum	352800

S.No	Particular	Unit	Value
4	Monetary benefit	(Rs. in Lakh)/annum	105.82
5	Debit equity ratio	Ratio	3:1
6	Simple payback period	Yrs	2.34
7	NPV	(Rs. in Lakh)	214.90
8	IRR	%age	29.98
9	ROI	%age	22.43
10	DSCR	Ratio	2.20
11	Process down time	Days	14

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible solution for Gujarat Dairy cluster.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Gujarat Dairy Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1 INTRODUCTION

1.1 Brief introduction about cluster

The global objective of the BEE SME programme is to improve the energy intensity of the Indian economy by undertaking actions in the SME sector which directly or indirectly produced 60% of the GDP. The immediate objective of this programme is to create the awareness to accelerate the adoption of EE technologies and practices in 29 chosen clusters in the SME sector through knowledge sharing, capacity building and development of innovative financing mechanisms. To build the energy efficiency awareness by funding/subsidizing need based studies in large number units in the SMEs and giving energy conservation recommendations including technology up-gradation opportunities.

Under "BEE-SME Programme - Gujarat Dairy", the primary task was to carry preliminary energy audit in 15 units & detail audit in 7 units. The aim of conducting preliminary energy audit in 15 Units is to identify the areas of high energy consumption and to carry out detailed audit and comprehensive technology gap assessment in remaining 7 Units. Preliminary energy audit has been carried out for, assessing the overall energy use in the unit, based on measurements such as various monthly energy consumption rate, production rate, temperature measurement of thermal & chilling system, illumination etc. Energy audit and Technology gap assessment study at the plant results in identification of the following energy saving opportunities and however the detail calculations of the identified saving measures is given in detail energy audit study.

The main form of energy used by the cluster units are grid electricity, Natural Gas, charcoal, lignite, and diesel oil. Major consumptions of energy are in the form of Natural Gas and lignite. Details of total energy consumption at Gujarat Dairy cluster are furnished in Table 1.1 below:

Table 1.1 Details of annual energy consumption

a) A Typical Dairy (With majority of products mix)

Energy Type	Unit	Monthly Average Consumption	% Contribution (MCal Basis)	% Contribution (Cost Basis)
Electricity	kWh	1539108	16%	53%
NG	SCM	597934	66%	25%
FO	Ltrs	141855	18%	22%

b) A Typical Milk Chilling Center

Energy Type	Unit	Monthly Average Consumption	% Contribution (MCal Basis)	% Contribution (Cost Basis)
Electricity	kWh	149056	14%	65%
FO	kgs	17671	59%	35%

Classification of Units

The Gujarat Dairy Cluster units can be broadly categorized into two types based on types of process.

- Milk Chilling Center
- Dairy Units

Preliminary Energy Carried in 15 Nos. of units out of which 12 Nos. milk chilling centers & 03 Nos. are dairies. Detailed Energy audit carried in 7 units out which 5 Nos. of Dairies & 02 Nos. of milk chilling center.

Products Manufactured

The various product manufactured in dairies covered under 'Gujarat Dairy Cluster' are as follow-

Dairies process following products from Milk while milk chilling center collects milk, weighs, chills & dispatch to dairy.

1) Tone Milk / Tea Milk
2) Tetra Pack Milk
3) Flavored Milk / Butter Milk
4) Curd
5) Milk Cream
6) Butter
7) Ghee
8) Paneer / Cheese
9) Skimmed Milk Powder / Whole Milk Powder
10) Baby Food (Milk Powder Based)
11) Ice Cream / Indian Sweets.

In dairy industry production capacity is mainly decided by milk processed in Kgs (Ltrs) per day.

Table 1.2 Details of types of product manufactured

Details of units of cluster subjected to Preliminary Energy Audit.

S.No.	Particulars of SME	Dairy / Chilling Center	Production Capacity in ltrs/day
1.	Unit 1	Dairy	25000
2.	Unit 2	Dairy	14500

S.No.	Particulars of SME	Dairy / Chilling Center	Production Capacity in ltrs/day
3.	Unit 3	Dairy	9000
4.	Unit 4	Chilling Center	30000
5.	Unit 5	Chilling Center	140000
6.	Unit 6	Chilling Center	165000
7.	Unit 7	Chilling Center	160000
8.	Unit 8	Chilling Center	160000
9.	Unit 9	Chilling Center	150000
10.	Unit 10	Chilling Center	140000
11.	Unit 11	Chilling Center	160000
12.	Unit 12	Chilling Center	36000
13.	Unit 13	Chilling Center	20000
14.	Unit 14	Chilling Center	20000
15.	Unit 15	Chilling Center	30000
16.	Unit 16	Dairy	160000
17.	Unit 17	Dairy	1280000
18.	Unit 18	Dairy	5000
19.	Unit 19	Dairy	500000
20.	Unit 20	Dairy	400000
21.	Unit 21	Chilling Center	450000
22.	Unit 22	Chilling Center	200000

Energy usages pattern

Electricity is mainly used for dairy cluster units apart from other fuels such as FO, PNG, Bio-mass (wood), HSD, LDO etc. The dairy wise the pattern varies.

The details of energy uses pattern are as given below-

Name of Unit	Electricity	FO	PNG	Wood	HSD	LDO	Other
Unit 1	☼	☼					
Unit 2	☼						
Unit 3	☼	☼					
Unit 4	☼				☼		
Unit 5	☼			☼		☼	
Unit 6	☼	☼					
Unit 7	☼	☼					
Unit 8	☼						
Unit 9	☼						
Unit 10	☼					☼	
Unit 11	☼	☼					
Unit 12	☼	☼					

Name of Unit	Electricity	FO	PNG	Wood	HSD	LDO	Other
Unit 13	☼			☼			
Unit 14	☼			☼			
Unit 15	☼	☼					
Unit 16	☼	☼	☼				
Unit 17	☼			☼			
Unit 18	☼	☼	☼				☼ (Castor DOC)
Unit 19	☼			☼ (Saw Mill Dust)			☼ (Steam from Outside)
Unit 20	☼	☼					
Unit 21	☼	☼					
Unit 22	☼	☼					

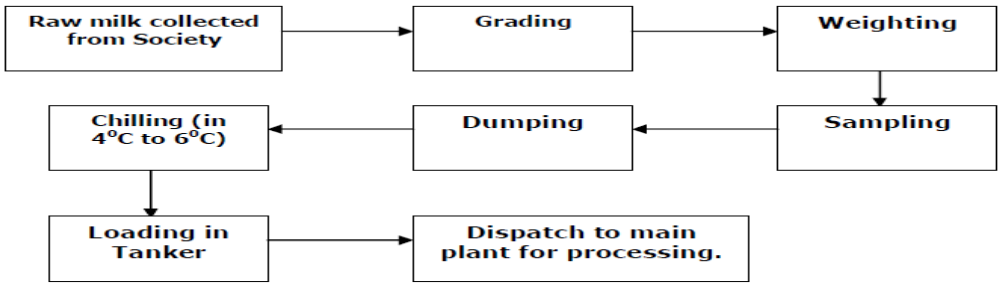
General production process for Dairy cluster

The units of Gujarat Dairy cluster are basically two types i.e. Milk Chilling Centers & Dairies. The process at milk chilling center is basically to collect the milk, segregation based on type of animal (cow or buffalo), weighing, Quality study, milk chilling & dispatch to mother dairy.

While the process at mother dairy comprises of various products mix such as packaged milk, curd, butter, butter milk, Ghee, Various types of milk powder etc.

Milk collection process involves Grading, Weighing (Milk is recorded in Kgs), Chilling, Dumping, Sampling, Loading in Tanker & dispatch to main processing plant. Most of the chilling centers are located in remote villages to collect the milk from various local 'Mandalis'. Now a days, a new trend of providing BMC (Bulk Milk Storage) is emerging. These give added advantages of directly preserving milk even in small space. At few places even BMC are further divided in small numbers & placed in various remote places.

Process Diagram for Typical Milk Chilling Center



Pasteurization

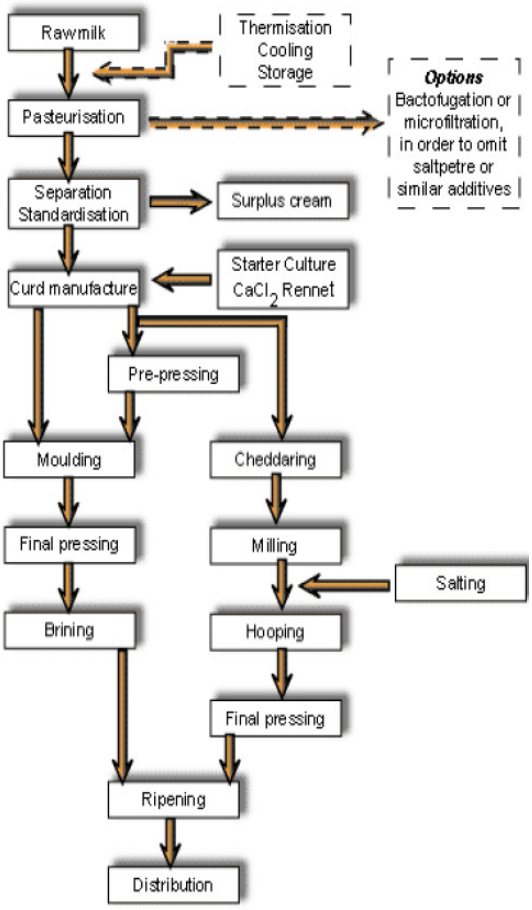
Pasteurization is the process that purifies milk and helps it stay fresher, longer. Milk is pasteurized by heating it to 72℃ for 16 seconds then quickly cooling it to 4℃. Pasteurization is named after Louis Pasteur, the famous scientist who discovered that the process destroyed

bacteria that naturally develops in raw milk. By destroying the bacteria, milk becomes safe to drink and holds its delicious flavor for much longer.

Homogenization

Milk must then be homogenized. Without homogenization, the milk fat would separate from the milk and rise to the top. Milk fat is what gives milk its rich and creamy taste. Homogenization makes sure that the fat is spread out evenly in the milk so that every sip of milk has the same delicious flavor and creamy texture. Milk is transferred to a piece of equipment called a homogenizer. In this machine the milk fat is forced, under high pressure, through tiny holes that break the fat cells up in to tiny particles, 1/8 their original size. Protein, contained in the milk, quickly forms around each particle and this prevents the fat from rejoining. The milk fat cells then stay suspended evenly throughout the milk.

Cheese Manufacturing Process



Packaging Milk

Milk is pumped through automatic filling machines direct into bags, cartons and jugs. The machines are carefully sanitized and packages are filled and sealed without human hands. This keeps outside bacteria out of the milk which helps keep the milk stay fresh. During the entire time that milk is at the dairy, it is kept at 1° - 2°C. This prevents the development of extra bacteria and keeps the milk it's freshest.

Cream Extraction & Butter

Milk cream is extracted from Milk using centrifuge. The butter making process involves quite a number of stages. The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer. The cream should be sweet (pH >6.6, TA = 0.10 - 0.12%), not rancid and not oxidized. If the cream is separated by the butter manufacturer, the whole milk is preheated to the required temperature in a milk pasteurizer before being passed through a separator. The cream is cooled and led to a storage tank where the fat content is analyzed and adjusted to the desired value, if necessary. The skim milk from the separator is pasteurized and cooled before being pumped to storage. It is usually destined for concentration and drying. From the intermediate storage tanks, the cream goes to pasteurization at a

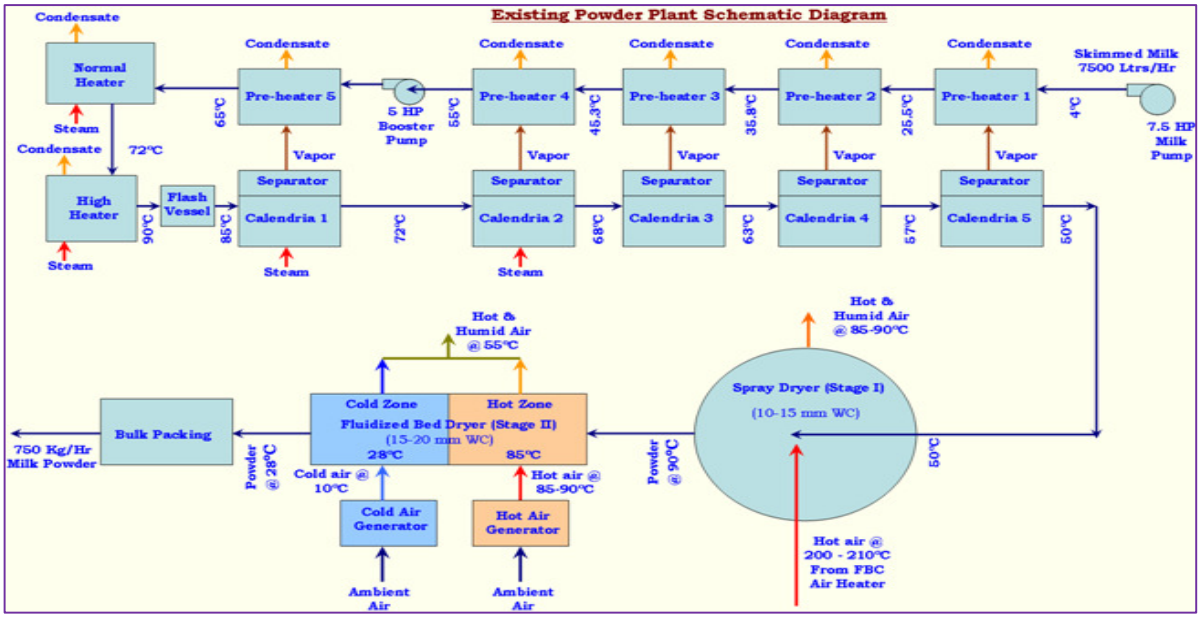
temperature of 95^{O}C or more. The high temperature is needed to destroy enzymes and micro-organisms that would impair the keeping quality of the butter.

Cheese

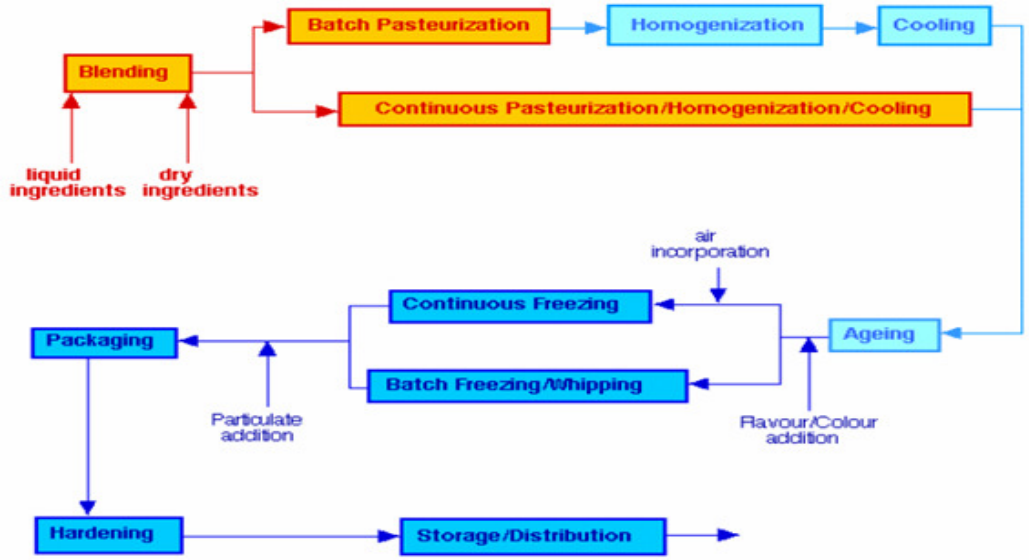
Cheese is an important product of fermentative lactic acid bacteria. Due to its reduced water content, and acidic pH, bacterial growth is severely inhibited.

Milk Powder

Skimmed Milk powder, Whole milk powder, baby food etc are various types of milk powder processes employed in units of dairy.



Ice Cream: The Ice cream process can be briefly explained from sketch below.



1.2 Energy performance in existing system

1.2.1 Fuel consumption

Average fuel and electricity consumption in a typical Gujarat Dairy Cluster unit is given in Table 1.4 below:

Table 1.3 Average fuel and electricity consumption

a) On Mcal Basis

Energy Type	Unit	Monthly Average Consumption	Monthly Consumption in MCal
Electricity	kWh	1539108	1323632.9
NG	SCM	597934	5381406.0
FO	Ltrs	141855	1489477.5
Total	MCal	-----	8194516.4

b) On Cost Basis

Energy Type	Average Monthly Consumption
Electricity	9988810.92
NG	4783472
FO	4113795
Total in Rs.	18886078

1.2.2 Average annual production

Annual production in terms of liters /year is taken in case of Milk and Milk products where semi solids and solids are in their liquid equivalent are given in the following Table 1.5 below:

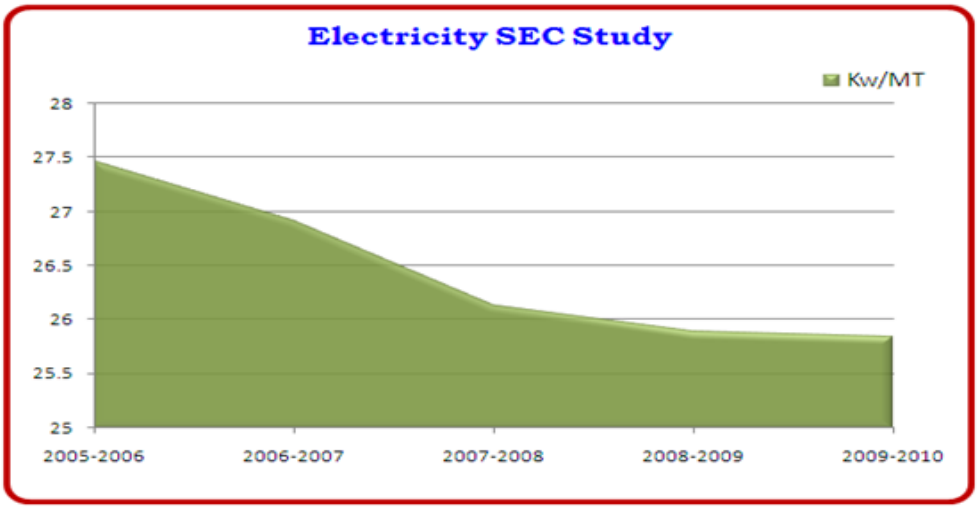
1.2.3 Specific energy consumption

In dairy industry the specific energy consumption individual product wise cannot be maintained due to wide range of production mix variation depending on market condition, season and availability of Milk etc

Table 1.4 Average annual production

Month	Butter	Ghee	Paneer	Khoa	Masti Dahi	Shrikhand	Amul Kool	S.M.P.	W.M.P.	Amulya	A.S.P.	White Butter
Apr-08	575978	189680	256118	1584	513452	143034	54316	173702	0	119587	1448676	0
May-08	507932	207837	249070	2194	534548	139859	112387	136202	197120	168263	1357065	0
Jun-08	364098	218436	221571	6272	428235	102749	79282	181035	156395	130695	1111404	0
Jul-08	286876	261851	140133	10430	465042	59437	20395	79653	156670	131594	872464	0
Aug-08	339197	286478	182647	25238	471037	171928	38304	179587	0	174919	1228071	0
Sep-08	491342	130691	211473	26482	476500	127843	0	188894	0	176953	1279321	0
Oct-08	417499	249239	243018	15382	565186	89376	47505	151032	0	65639	1692232	0
Nov-08	641696	242069	199052	4160	471105	89793	46766	324071	0	108567	1279682	0
Dec-08	886070	276967	265026	2004	462144	83644	10531	673321	0	123342	1180249	20500
Jan-09	850727	332264	224976	3952	461303	80787	21811	755462	0	80019	1236977	148035
Feb-09	792976	216979	230908	1238	436874	189645	4570	444278	70560	76862	1190432	48510
Mar-09	830203	242737	246304	768	619591	260349	64675	280888	0	89862	1711364	0
Apr-09	592886	232994	241562	9268	729099	159234	42346	247185	0	114262	1469411	10740
May-09	343760	202062	222580	6238	756364	193894	49075	206245	0	127661	1385012	0
Jun-09	190937	196763	259340	2430	717423	106483	59928	139687	0	81213	854819	0
Jul-09	267301	302857	57230	7104	663288	120180	10862	21075	0	15541	646280	0
Aug-09	360404	150111	142175	21386	729928	159988	16555	55147	0	92258	1024997	0
Sep-09	326550	256971	138200	15868	593518	98544	30619	100520	0	31009	999004	6150
Oct-09	503432	228263	180021	20136	620770	93232	32362	170815	0	72966	1404444	0
Nov-09	582951	243360	162538	3564	486056	44187	17453	288975	0	197931	1650920	0
Dec-09	563161	243172	213106	3126	481483	97244	45336	323287	0	81506	1576643	147630
Jan-10	941065	184012	236080	5884	459258	86421	57922	315275	0	46227	1663932	37605
Feb-10	818991	181823	197486	8352	487500	174375	57158	286889	0	108915	1458871	5220
Average	542436	229462	205244	8829	549118	124879	40007	248836	25250	105034	1292273	18452

Electricity SEC Study in Dairy Cluster Over Past Few Years



Thermal Energy SEC Study in Dairy Cluster over Past Few Years

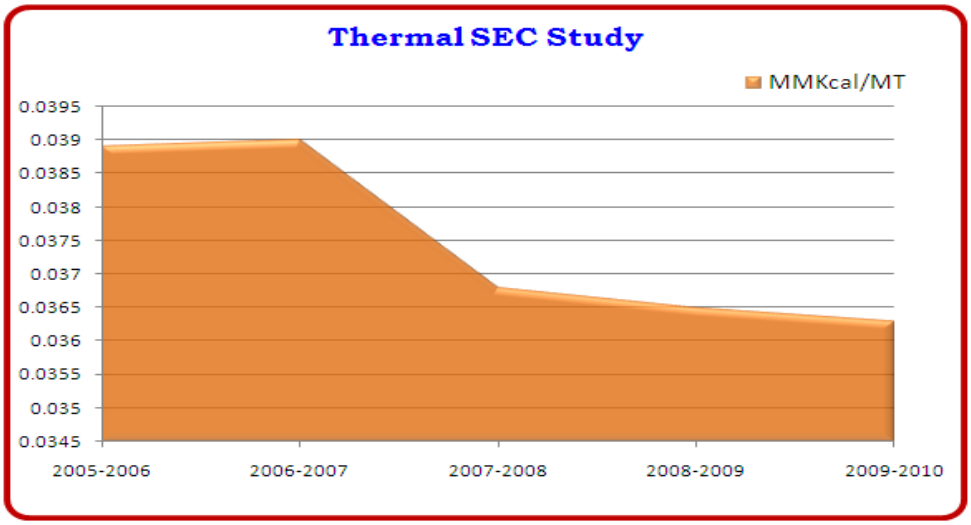


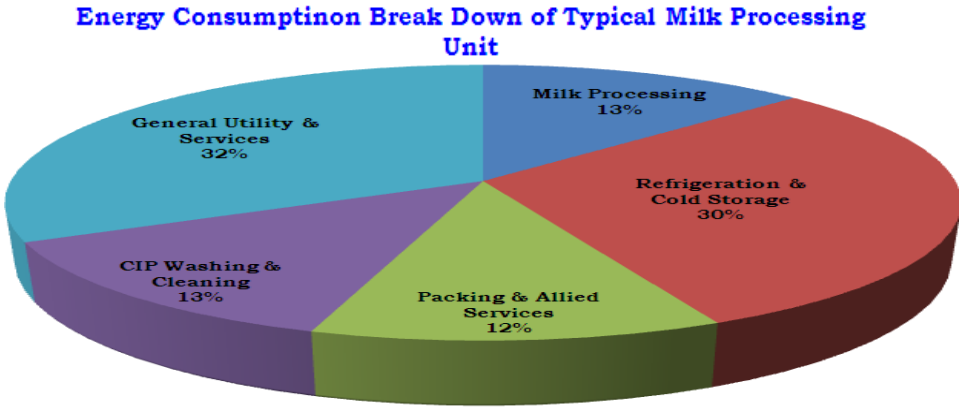
Figure 1.1 SEC Study in Dairy Cluster over Past Few Years

Process (Main Equipments) wise cost of energy consumption

The specific energy consumption of the typical Industry is as given in Table 1.6 below-

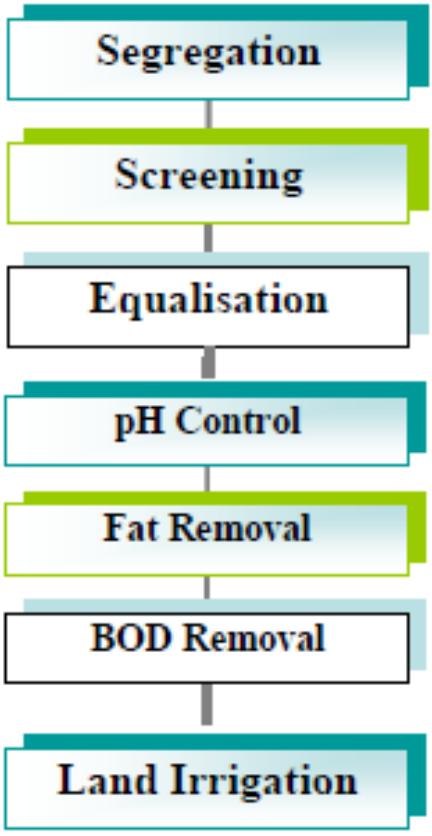
Table 1.5 Process wise (Main Equipment) wise cost of energy consumption

S.No.	Process Name	% age of Cost
1	Milk Processing	13
2	Refrigeration & Cold Storage	30
3	Packing & Allied Services	12
4	CIP Washing & Cleaning	13
5	General Utility & Services	32



1.3 Existing technology/equipment

1.3.1 Description of existing technology



The waste generated from dairy unit is categorized as a high organic waste with extremely high values of BOD and COD. The wastewater generated from the unit will have various pollutants which exert high BOD and COD load. Presently this waste is treated using aerobic treatment to reduce this load and bring down the BOD /COD levels within acceptable limits for discharge outside plant. However present system consumes lot of energy to treat the waste water

Aerobic biological treatment methods depend on microorganisms grown in an oxygen-rich environment to oxidize organics to carbon dioxide, water, and cellular material. Systems of aerobic treatment can include the conventional activated sludge process, the rotating biological contactors, the conventional trickling filters, etc

The highly variable nature of dairy wastewaters in terms of volumes and flow rates (which is dependent on the factory size and operation shifts) and in terms of pH and suspended solid (SS) content (mainly the result of the choice of cleaning strategy employed) makes the choice of an effective wastewater treatment regime difficult. Because dairy wastewaters are highly biodegradable, they can be effectively treated with biological wastewater treatment systems, but can pose a potential environmental hazard if not treated properly. Currently aerobic type of effluent treatment plant provided with 30 kW of electricity consumption for various processes.

The volume, concentration, and composition of the effluents arising in a dairy plant are dependent on the type of product being processed, the production program, operating methods, design of the

processing plant, the degree of water management being applied, and subsequently the amount of water being conserved. Dairy wastewater may be divided into three major categories:

1. ***Processing water*** (water used in the cooling and heating processes). These effluents are normally free of pollutants and can with minimum treatment be reused or just discharged into the storm water system.

2. ***Cleaning wastewaters*** emanate mainly from the cleaning of equipment that has been in contact with milk or milk products, spillage of milk and milk products, whey, pressings and brines, CIP cleaning options, and waters resulting from equipment malfunctions and even operational errors.

3. ***Sanitary wastewater***, which is normally piped directly to sewage works

The existing observed parameters of typical dairy can be as given below-

SN	Parameter	Units	Raw Waste Water
1.	pH	-	7.0 to 8.0
2.	Temperature	°C	Ambient
3.	Suspended Solid	mg/L	500
4.	Oil and Fats	mg/L	< 10
5.	COD	mg/L	1500 to 5000
6.	BOD	mg/L	1000 to 2500

Energy charges

Table 1.6 Energy charges

S. No.	Contract Demand, KVA	Energy Charges, Rs/kWh
1	Upto 1000	3.85
2	From 1001 to 2500	4.05
3	Above 2500	4.15

Demand Charges

Table 1.7 Demand charge

Sr. No.	Billing Demand, KVA	Demand Charges, Rs/KVA
1	For first 500	98
2	For next 500	139
3	For next 1500	208
4	Billing demand in Excess of 2500	237
5	Billing Demand Excess of contract demand	369

Therefore, total electricity Charges (including the maximum demand charges & other taxes) is Rs. 6.49 per kWh in considered case.

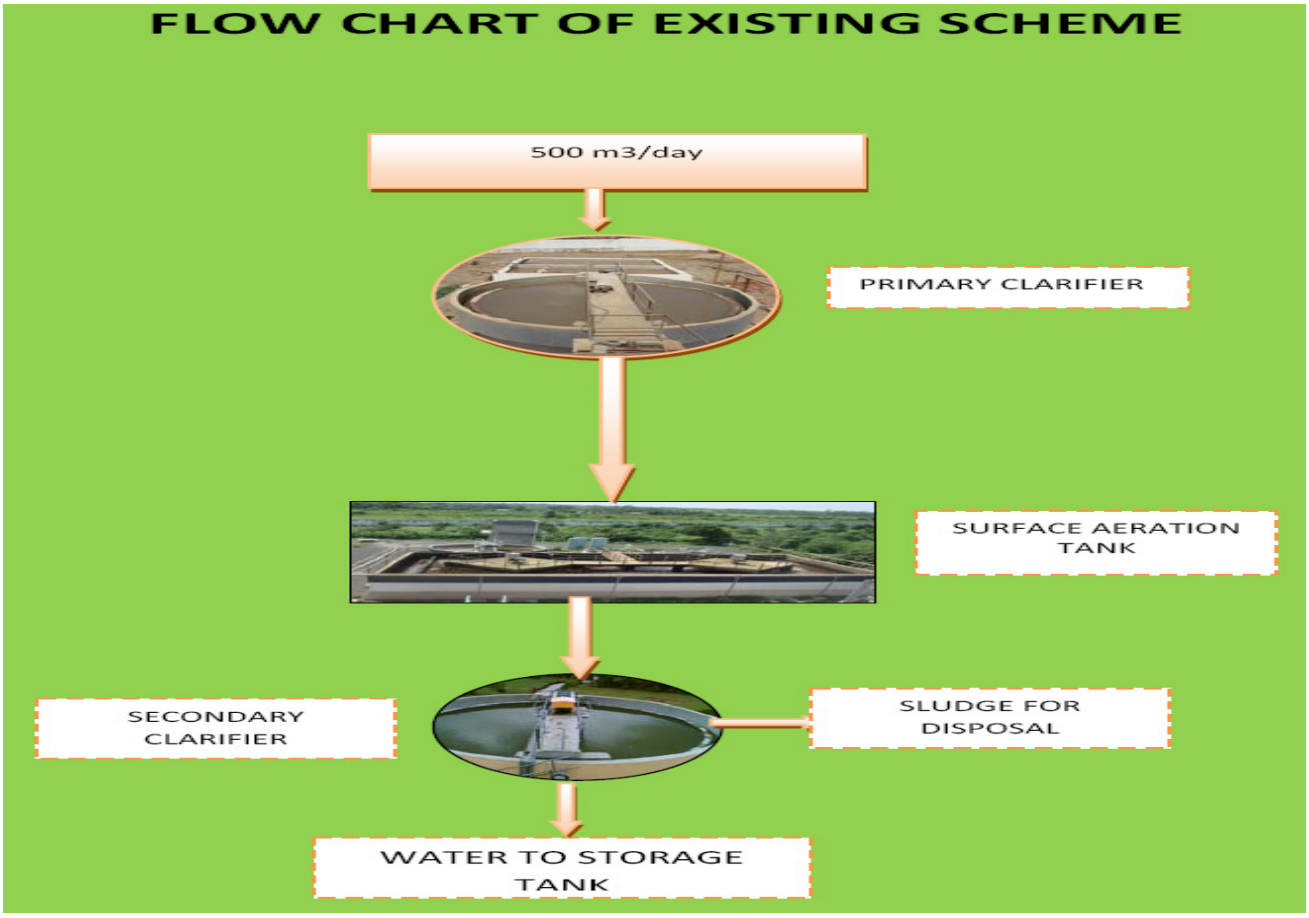
1.3.2 Role in process

Effluent treatment is very essential in process. The environmental law at both state and central government level prescribes norms for effluent. The performance of effluent treatment has major impact on the environment. The methane gas liberated in conventional aerobic treatment has negative impact. By capturing methane the environment will be benefited enormously.

1.4 Baseline establishment for existing technology

The existing aerobic treatment of the effluent results in substantial release of methane in atmosphere along with more electrical energy consumption. Existing aerobic effluent treatment comprises of following main steps

a) Primary Clarifier
b) Surface aeration tank
c) Secondary Clarifier



Sr. No.	Unit	Installed HP	Working HP
1.	Sludge pumps for clarifier 'A'	4.0	2.0
2.	Clarifier Mechanism	1.0	1.0
3.	Nutrients dosing system	2.0	2.0
4.	Surface aerator for aeration tank	120.0	120.0
	Total	127HP / 95.25kW	125 HP / 93.75 kW

Along with loss of methane as fuel, about 10 to 15 kW actual excess electricity is consumed in existing system.

1.4.1 Design and operating parameters

Methane Generation Study

Untreated Effluent Data			
S.no.	**Parameter**	**Unit**	**Value**
1)	BOD	mg/Ltrs	2500
2)	COD	mg/Ltrs	5000
3)	Effluent Quantity	Ltrs/Hr	41666
Calculations for Bio-gas Generation			
1)	COD Load per Day	Kg/Day	5000
2)	COD Reduction Percentage Considered	%	80
3)	Actual Reduced COD Load	Kg/Day	4000
4)	Bio-gas (Methane) Generated	m^3/Kg of Reduced COD Load	0.5
5)	Thus Actual Bio-Gas Generated	m^3/Day	2000
6)	Calorific Value of Bio-Gas	Kcal/m^3	4900
7)	Total heat that can be generated from Bio-gas	Kcal/Day	9800000
8)	Calorific Value of FO	Kcal/Ltrs	10000
9)	FO Equivalent of Bio-gas Generated	Kg/Day	980
9)	Total FO Equivalent of Bio-gas Generated per Annum	kgs/annum	352800

(1 Kg=1000000 mg & Considering for ETP, 1Kg=1Ltr)

BASIS OF PLANT DESIGN

Source

The raw effluent shall be discharged to existing pretreatment unit from the CIP section of milk processing and product manufacturing equipments, floor washing, etc. This pretreated effluent will be feed for proposed bio-digester section.

Quantity

The quantity of effluent to be treated shall be 1000 m^3/day.

Capacity of the Effluent Treatment Plant (ETP)

The Bio Digester section will be designed on the basis of the following Influent characteristics

Total wastewater generation: 1000 m^3/day

Sr. No.	Parameter	Units	Raw Waste Water
1.	pH	-	7.0 to 8.0
2.	Temperature	°C	Ambient
3.	Suspended Solid	mg/L	500
4.	Oil and Fats	mg/L	< 10
5.	COD	mg/L	max. 5000
6.	BOD	mg/L	max. 2500

The effluent coming out of the proposed Bio Digester plant should confirm the following characteristics:

Sr. No.	Parameter	Units	Treated Water
1	ph	-	7.0 to 8.0
2	Temperature	°C	40°C
3	Suspended Solid	mg/L	<100 mg/L
4	Oil and Fats	mg/L	<10
5	COD	mg/L	<1000
6	BOD	mg/L	<500

Bio-gas production: 0.45 to 0.5 m^3/kg of C. O. D. removed

Bio-Gas Generation : 2000 m^3/day

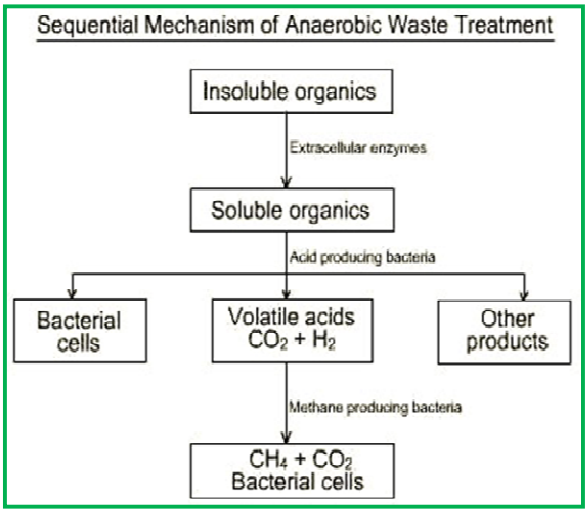
Gas Composition:

i. Methane content : 52% to 65 %

ii. Hydrogen Sulfide : 1.5 % to 2.5 %

iii. Carbon Dioxide : 38 % to 46 %

iv. Calorific value : 4900 Kcal/Cu.mtr.



FUNDAMENTAL MICROBIOLOGY

The anaerobic treatment of organic wastes resulting in the production of carbon dioxide and methane, involves two distinct stages. In the first stage, complex waste components, including fats, proteins, and polysaccharides are first hydrolyzed by a heterogeneous group of facultative and anaerobic bacteria. These bacteria then subject the products of hydrolysis to fermentations, oxidations, and other metabolic processes leading to the formation of simple organic compounds, mainly short-chain (volatile) acids and alcohols. The first stage is commonly referred to as "*acid fermentation*". However

in the second stage the end products of the first stage are converted to gases (mainly methane and carbon dioxide) by several different species of strictly anaerobic bacteria. This stage is generally referred to as "*methane fermentation*".

Acetic acid:

$CH_3COOH \rightarrow CH_4 + CO_2$

Propionic acid:

Ist Step:

$CH_3CH_2COOH + 0.5\ H_2O \rightarrow CH_3COOH + 0.75CH_4 + 0.25CO_2$

IInd Step:

$CH_3COOH \rightarrow CH_4 + CO_2$

Overall:

$CH_3CH_2COOH + 0.5\ H_2O \rightarrow 1.75CH_4 + 1.25CO_2$

The primary acids produced during acid fermentation are propionic and acetic acid. It is reported that only one group of methane bacteria is necessary for methane fermentation of acetic acid, whereas propionic acid, which is fermented through acetic acid requires two different groups of methane bacteria. The methane fermentation reactions for these two acids are:

The bacteria responsible for acid fermentation are relatively tolerant to changes in pH and temperature and have a much higher rate of growth than the bacteria responsible for methane fermentation. As a result, methane fermentation is generally assumed to be the rate limiting step in anaerobic wastewater treatment.

UP-FLOW ANAEROBIC SLUDGE BLANKET REACTOR (UASB):

Wastewater from the buffer tank shall then be pumped to UASB reactor through a specially designed distribution pipes. The multiple distributions ensures uniform distribution of flow throughout the sludge blanket making maximum rises to the top of Anaerobic reactor along with bio-gas generated and also some sludge particles. A unique three-phase gas – solid – liquid separator shall be provided at the top to separate out the gas, liquid and the sludge particles. Gas will be collected in the domes provided at the top. The liquid overflows through the gutters and suspended solids then separated are allowed to settle down in the sludge blanket thereby retaining valuable bacterial population.

The gas will be carried through a gas line equipped with safety devices to gas holder. Gas will be supplied to users in plant as per requirement. Excess gas will be burnt at the flare stack. The UASB shall be constructed in RCC M-20. It shall include standard peripheral approach ladder in M.S. and an RCC inspection platform at the top level. A standard high handrail in MS pipe shall be provided along the outer side and sides of the platform, and along the periphery of the UASB top. Necessary arrangement for access in to the UASB shall be included in the form of side manhole at least 600 mm dia. CI rungs shall be provided at a suitable location in the tank for access from the manhole to the tank bottom.

At minimum three locations, sludge outlets connected to a common sludge line for sampling/excess sludge disposal to the sludge pit shall be provided. Pipe inserts with puddle flange shall be provided at all effluent/sludge inlet/outlet points. The overflow from the bio-digester will be send to clarifier A for settling of overflow solids.

CLARIFIER A

The overflow from UASB Reactor will enter into primary Clarifier. The suspended solids settled at the bottom of the clarifier will be sent back to buffer tank. The overflow from clarifier will be send to Pre aeration tank.

PRE AERATION TANK:

The effluent after anaerobic treatment has dissolved gases, to expel out these dissolved gases the aeration is carried out in pre aeration tank.

GAS HOLDER / GAS COLLECTION SYSTEM:

The biogas generated from UASB reactor is collected in the floating gasholder. A floating gas holder type bio-gas unit consists of i) Gas Holder, ii) Inlet & outlets assembly and iii) Water removal device.

The gas holder consists of a guide rollers fitted into the brackets on the circumference of the gas holder tank, slides inside the C channels fixed to the RCC tank wall, a cylindrical tank made of mild steel sheet painted with epoxy coating. The gas holder tank will be kept upside down so that it immersed in the water. It collects gas which comes out of the UASB and moves up. When the gas outlet is opened, the gas so collected is pushed out into the pipeline by the weight of the tank itself, at a constant pressure of 8 to 10 inches of water column. The drum then moves down this up and down movement of the drum is guided by a guide rollers fitted into the brackets on the circumference of the gas holder tank, slides inside the C channels fixed to the RCC tank wall.

FLARE STACK

The excess Bio-Gas can be burnt at flare stack. The flare stack shall be provided in MS pipe in pipe arrangement with an outer protecting shell and inner gas transmission line leading to the burner. The stack shall be provided with a suitable concrete foundation, necessary bends, specials, etc. complete, well grouted. An approach ladder shall be provided up to the top of the stack for gas flaring. Before installing the stack the outer surfaces of the inner and outer pipes shall be provided with one coat of red oxide primer followed by two coats of enamel paint of approved make and shade for weather protection.

ADVANTAGES OF BIO-DIGESTER SYSTEM

- ***Higher Organic Loading Rate*** UASB reactor can handle higher organic loading rates thus reduces the reactor volume.
- ***Low Capital Cost*** As media is not required for carrying biomass. Thus UASB reactor is cheaper.
- ***Faster Restart*** The system restarts within a short time even after a longer shut down.

- ***More Rugged System*** Due to its in-built buffering capacity UASB reactor can withstand variations in flow, pH, COD concentration etc without system going sour.
- ***Low Operating Cost*** As there is no moving part inside the system, it has lowest power consumption i.e. only for feed and re-circulation pumps.
- ***Higher Digestion*** UASB reactor reduces initial BOD up to 80% & produces appreciable amount of biogas.
- ***Easy Maintenance*** As there are no moving parts inside the digester, no pulsating flows, no backwashes, and no sludge recycle, the system is easy to operate and maintain.
- ***CHEMICALS & NUTRIENTS*** Chemicals & Nutrients such as Urea, Super Phosphate is required only during the start up and not after the plant is stabilized.
- ***Appearance*** The system is esthetically pleasing and extremely neat and clean.
- ***Life Cycle Cost*** Life cycle cost of UASB reactor is the lowest because of :
  - Lowest operation & maintenance cost and
  - High and consisted biogas generation compared to other anaerobic systems.
- ***Low Power Requirement*** As compared to conventional treatment processes like Activated Sludge Process Anaerobic requires less power.
- ***Less Sludge Generation*** Because of higher solid retention time, quantity or sludge generated in UASB process is very less. Hence, it requires less sludge drying beds area and the capital cost of system gets reduced.

1.4.2 Operating efficiency analysis (Existing Loss Study)

- The energy consumption for aerobic effluent treatment is higher by 10 kW (Based on actual measured kW)
- Currently as methane is not captured, the same is liberated in atmosphere.
- As the methane is not captured additional fuel is consumed in boilers and hot air generators

1.5 Barriers in adoption of proposed equipment

1.5.1 Technological barrier

In Gujarat Dairy Cluster, overall technical understanding on Dairy product manufacturing is good and rapidly increasing. Many of the dairy engineers/managers are well informed and ready to adopt new technology. It has been observed that at cluster level there is committed interested for leadership and following up is quick. In general, there is readiness to adopt provided delivery, outcome and results are demonstrated.

The technologies need to be demonstrated within the cluster. While carrying out the audits and presenting the Energy audit reports to the units, in the discussion with the plant owners & other personnel, they agreed with most of the identified energy saving measures and technologies.

There appears to be no technological barrier. While carrying out the audits and presenting the Energy audit reports to the units, it was found that significant energy can be saved by provision of energy efficient electric motor. And hence there is a need for a better technology for efficient energy management.

1.5.2 Financial barrier

Availing finance is not the major issue. Among the SMEs, the larger units, if convinced are capable of either financing it themselves or get the finance from their banks. The smaller units will require competitive loan and other support to raise the loan. However as most of them have been able to expand their setup and grow, there is readiness to spend for energy efficiency technologies which have good returns. Energy Efficiency Financing Schemes such as SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies.

The cluster has significant potential of technological up gradation. However though there are good returns, this project is highly capital intensive and requires support of policy as well as innovative financial mechanisms. CDM needs to be duly applied to generate additional cash flow to further improve the returns from the project.

1.5.3 Skilled manpower

In Gujarat Dairy cluster, the availability of skilled manpower is one of the problems due to more number of units. Local technical persons available at individual location take care of maintenance or repair works of major equipments. Maintenance or repair work of major equipments of Dairy units like ammonia compressors, hot air generators for spray dryers etc, are generally taken care by the equipment suppliers itself as they station one of their experienced technical representatives at Ahmadabad for the maintenance work.

Specialized and focused training of the local service providers on better operation and maintenance of the equipments, importance of the energy and its use and energy conservation measures will improve awareness among the unit owners and workforce. Original equipment suppliers should also participate in these programs.

1.5.4 Other barrier (If any)

No other barrier is seen. It appears that apart from high initial cost of energy efficient electric motor, there is no other barrier.

2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

A. Power requirement

Sr. No.	Unit	Installed HP	Working HP
1	Feed Pumps for UASB	10	7
2	Sludge pumps for clarifier 'A'	4.0	2.0
3	Clarifier Mechanism	1.0	1.0
4	Blowers for pre aeration tank	10.0	5.0
5	Bio-Gas Blowers	6.0	3.0
6	Feed pump for aeration	10.0	5
7	Nutrients dosing system	2.0	2.0
8	Total	43HP / 32.06 kW	25 HP / 18.64kW

B. Manpower required

Skills	No. of Persons
Plant In- charge / Chemist	1 person
Operators	1 Person / shift
Helper	2 person / shift

C. Chemical and Nutrients

Following chemicals shall be required during commissioning and steady state operation of the plant. Exact qty will be determined during the commissioning of ETP.

- Urea
- DAP
- Lime – as per process requirement
- Sodium Bi Carbonate
- For anaerobic treatment, Anaerobic sludge/cow dung will be required around 50,000 liters at the start of commissioning.

2.1.1 Detailed of proposed equipment

Basic Treatment Units

The wastewater treatment system on the basis of the above parameters to be provided in four stages

Pre-Treatment (Existing)

- Screening
- Oil and Fat removal

- Equalization
- Primary clarifier
- Buffer tank (new)

Secondary Treatment: **Biological** treatment to remove BOD and COD & to decompose organic matter.

- First stage Anaerobic Treatment consisting of following treatment unit (New)
  - UASB (Up flow Anaerobic Sludge Blanket Reactor)
  - Clarifier A
  - Pre-aeration
- Second Stage Aerobic Treatment consisting of following treatment units**(Existing)**
  - Extended aeration system.
  - Secondary Clarification
- Polishing Treatment (Existing)
  - Treated water / Chlorine contact tank
  - Pressure Sand Filter
- Sludge Management & Disposal (Existing)

Sludge disposal – to separate the sludge from the thick slurry

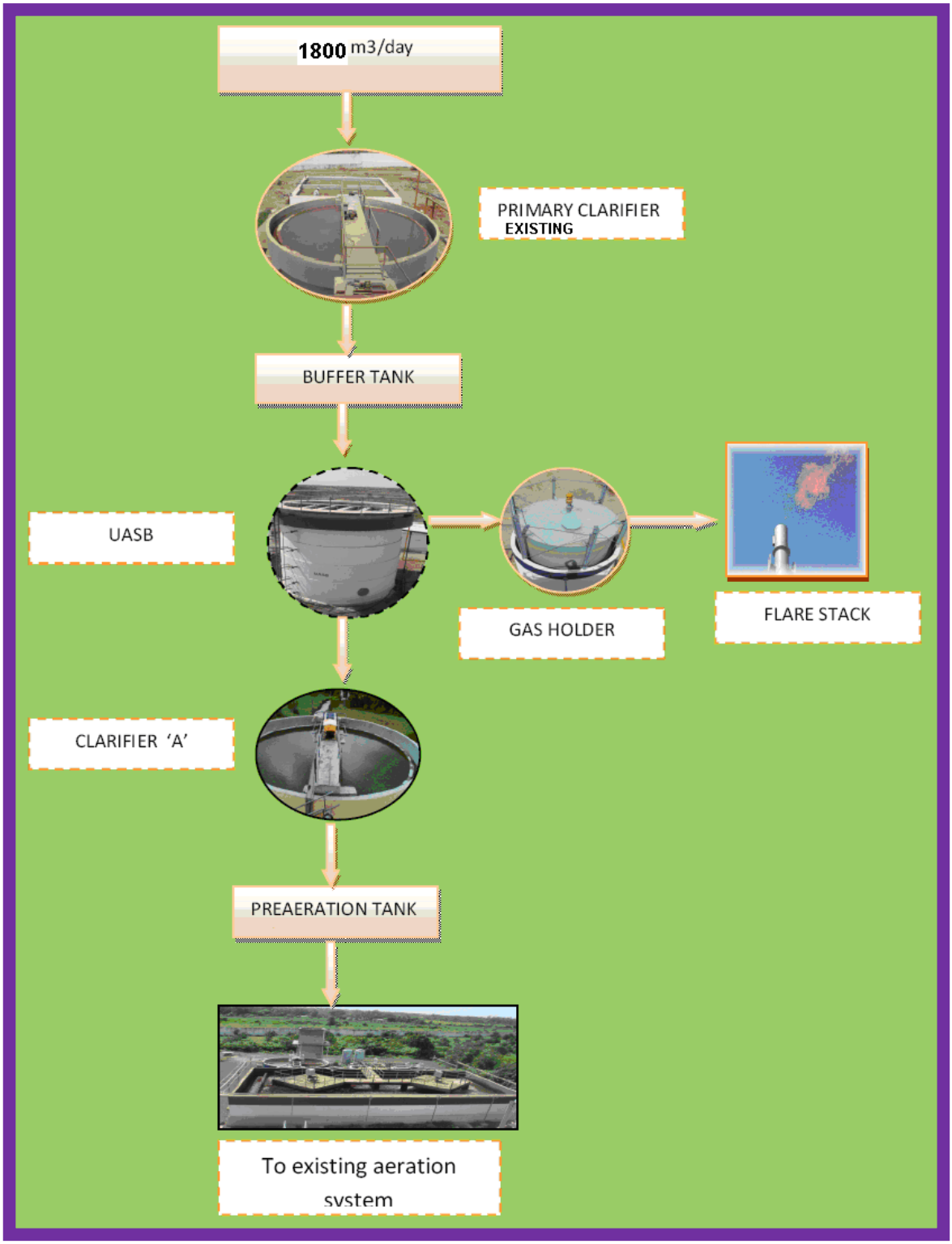
- Drying bed

OPERATIONAL PROCESSES

BUFFER TANK: The treated water from pretreatment system after existing primary clarifier enters into buffer tank. In buffer tank Urea and DAP will be added as nutrients. The tank is also acts as sump for the feed to UASB.

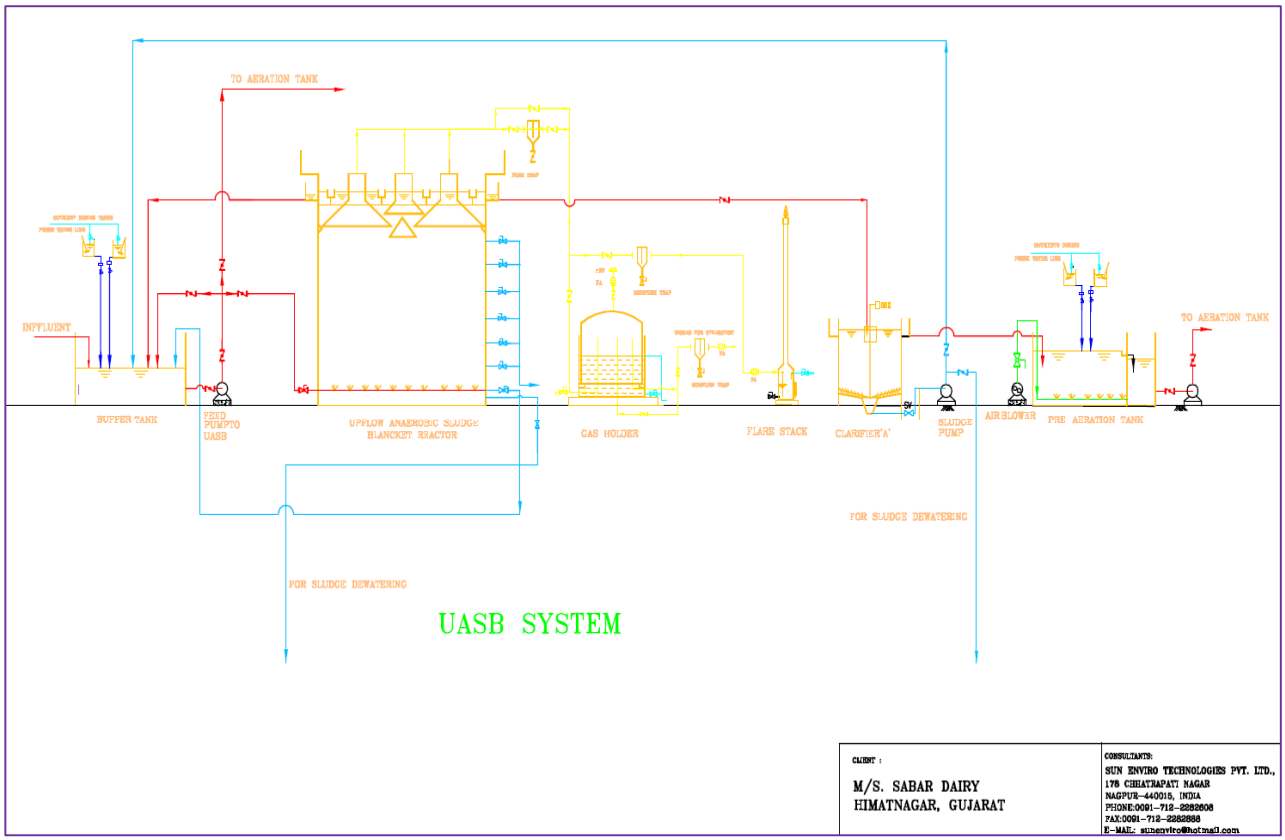
ANAEROBIC TREATMENT The anaerobic waste treatment process is an effective method for the treatment of many organic wastes. The treatment has a number of advantages over aerobic treatment process, namely,

- The energy input of the system is low as no energy is required for oxygenation,
- Lower production of excess sludge(biological synthesis) per unit mass of substrate utilized,
- Lower nutrient requirement due to lower biological synthesis, and
- Degradation leads to production of biogas which is a valuable source of energy.


1800 m3/day
PRIMARY CLARIFIER
EXISTING
BUFFER TANK
UASB
GAS HOLDER
FLARE STACK
CLARIFIER 'A'
PREAERATION TANK
To existing aeration system

2.1.2 Equipment/technology specification

FLOW CHART FOR BIODIGESTOR SYSTEM



P & Id for Biodigestor System

2.1.3 Integration with existing equipment

It is proposed that initially the anaerobic digestion system will be installed in parallel to existing system & once the system is ready it will connected to existing aerobic system. No problems are foreseen for integration with existing system.

2.1.4 Superiority over existing system

The proposed anaerobic effluent treatment system for methane capture is more energy efficient than existing one and are technologically superior. Use of this technology reduces the overall plant energy cost. It also reduces the dependency for electricity on the state electricity grid. The proposed measure bears better technology than the existing one, which results both energy saving & technological up gradation.

The following are the reasons for selection of this technology

- The proposed system is compact and saves space.
- It will reduce the total operating energy cost of the plant.

- It reduces the GHG emissions
- This project is also applicable for getting the carbon credit benefits.
- It is a clean technology.

2.1.5 Source of equipment

Methane capture systems are running successfully and the unit owners had observed the savings in terms of energy. The proposed equipments are available within India. All LSP identified are Indian firms.

2.1.6 Availability of technology/equipment

Suppliers of this technology are available at local level as well as at international level very easily. Even most of the suppliers took initiative and interacting with the dairy unit owners for creating the awareness of use of this technology.

2.1.7 Service providers

Details of technology service providers are shown in Annexure 7.

2.1.8 Terms and conditions in sales of equipment

The suppliers have already extended standard warrantee conditions for exchange, replace or repair against manufacturing defects for a period of 12 months after the date of commissioning. Promoters will have to promptly notify the supplier in writing of obvious defects or deficiencies after detection thereof. Replaced parts shall become the property of the supplier upon request of the supplier.

Supplier is not liable or defects or deficiencies which are resulting from the following reasons, as long as they are not resulting from a default of Supplier: Improper, unsuitable or negligent use, handling and/or operation of the system by promoters or by third parties; use of spare parts other than Genuine Parts; normal wear and tear; use of unsuitable consumables (such as, fuel, oil cooling liquid or any other consumables), particularly the use of consumables not conciliated in the operation manuals; improper building ground; chemical, electro- chemical or electric influences.

All conditions associated with this system are standard in nature. No special clause is incorporated. The conditions are very common in most of the plant & machinery sales.

2.1.9 Process down time

Process down time of Units of about 14 days will be required for the integration with the existing system.

2.2 Life cycle assessment and risks analysis

Life of the equipment is about 15 years. Risk involves in the installation of proposed project are as follows:

- Risk involved in delay in implementation of the proposed project is due to the high initial investment cost.

2.3 Suitable unit for implementation of proposed technology

The measure & technology is suitable for 2 dairy units under the Gujarat Dairy Cluster & similar units outside cluster. This measure in fact will result in technological up gradation in vital energy consuming area of these units. Majority of the dairies & Milk chilling centers (22 numbers in cluster) are suitable for implementation of at least anaerobic treatment of effluent instead of aerobic treatment of effluent.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 TECHNICAL BENEFIT

3.1.1 Fuel saving

FO or equivalent fuel as mentioned in cost benefit analysis will be saved due to usage of captured methane. Also due to downgrading of aerobic treatment, some electricity as mentioned in cost benefit analysis will be saved. Total FO saving would be 352800 liter per annum.

3.1.2 Electricity saving

It is estimated that this system will save 54000 kWh per annum (4.64 KLOE per Annum) for the unit.

3.1.3 Improvement in product quality

The measure does not have any impact on quality of product ***directly or indirectly***.

3.1.4 Increase in production

Production will be the same as in present.

3.1.5 Reduction in raw material

Raw material consumption is same even after the implementation of proposed technology.

3.1.6 Reduction in other losses

No impact on other losses ***directly or indirectly***.

3.2 Monetary benefits

Implementation of project will result in good, consistent monetary benefit (105.82 Lacs). It is estimated that this system will save on an average 54000 kWh/Annum will be saved for the unit Please refer following table.

Table 3.1 Energy and monetary benefit (For One Typical Unit of Gujarat Dairy Cluster)

Energy and monetary benefit			
S. No.	**Parameters**	**Unit**	**Value**
1)	Bio-gas (Methane) Generated	m^3/Kg of Reduced COD Load	0.5
2)	Thus Actual Bio-Gas Generated	m^3/Day	2000
3)	Calorific Value of Bio-Gas	Kcal/m^3	4900
4)	Total heat that can be generated from Bio-gas	Kcal/Day	9800000
5)	Calorific Value of FO	Kcal/Ltrs	10000
6)	FO Equivalent of Bio-gas Generated	Ltrs/Day	980
7)	Total FO Equivalent of Bio-gas Generated per Annum	Ltrs/annum	352800
8)	Cost of FO	Rs./Ltrs	29

9)	Saving from Bio-gas Generation	Rs./Day	28420
10)	Additional Saving of Electricity By anaerobic treatment instead of Aerobics Treatment	kWh/annum	54000
11)	Cost of electricity	Rs./ kWh	6.49
12)	Total Saving in Rupees per annum due to anaerobic treatment per annum	Rs./Annum	350460
13)	No. of Working Days/Annum	Days	360
14)	Total Expected Saving per Annum	Rs./Annum	10581660
15)	Expected KLOE Saving Per Annum	KLEO/Annum	2025
16)	Expected Investment for Civil Work, Mechanical Works, electrical works etc	Rs.	24756000
17)	Simple Payback Period	Yrs	2.34
		Months	28
18)	Expected FO Equivalent Saved per Annum	Liter/Annum	352800

*****Further details of total monetary benefit are given in Annexure 3.***

3.3 SOCIAL BENEFITS

3.3.1 Improvement in working environment

Use of energy efficient electric motor technology in Dairy Industry reduces the energy consumption.

3.3.2 Improvement in workers skill

Technical skills of persons will definitely be improved. As the training will be provided by equipment suppliers which improve the technical skills of manpower required for operating of the equipment and also the technology implementation will create awareness among the workforce about energy efficiency and energy saving.

3.4 ENVIRONMENTAL BENEFITS

3.4.1 Reduction in effluent generation

There is no impact in effluent generation due to implementation of the project.

3.4.2 Reduction in GHG emission

Implementation of this technology will reduce the CO_2 emissions. Reduction in CO_2 emissions will be possible due to Energy saving. This project will be able to reduce 3535 tonnes of carbon produced annually (46 tonnes on electricity saving in the process and 3490 tonnes reduction of consumption of fuel and amount of bio gas produced).

3.4.3 Reduction in other emissions like SO_X

Amount of SO_X will be reducing due to improved efficiency of the power plants due to better plant load factor.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 COST OF PROJECT

4.1.1 Equipment cost

Cost of Energy efficient motor with installation, erection, commissioning, standard mountings & accessories including taxes are Rs. 247.56 Lacs per 1000 m^3/hr effluent flow rate system.

4.1.2 Erection, commissioning and other misc. cost

The details of project cost is as given in table 4.1 given below-

Table 4.1 Details of proposed technology project cost

Details of Proposed Technology Project Cost			
SN	**Particulars**	**Unit**	**Value**
1	Cost of Retrofit/Additional Plan & Machinery For Energy Saving	Rs. (in Lacs)	135.5
2	Detail Engineering, Design & related expenses	Rs. (in Lacs)	9.5
3	Erection & Commissioning cost	Rs. (in Lacs)	20
4	Cost of civil work	Rs. (in Lacs)	80
5	Custom Clearance & Transportation Charges	Rs. (in Lacs)	0
6	Import duty	Rs. (in Lacs)	0
7	Other charges (Including Contingency 10%)	Rs. (in Lacs)	2.56
	Total cost	Rs. (in Lacs)	247.56

4.2 ARRANGEMENTS OF FUNDS

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost i.e. Rs. 61.89 Lakh & financial institutes can extend loan of 75%.

4.2.2 Loan amount.

The term loan is 75% of the total project cost i.e. Rs. 185.67 Lakh, with repayment of 7 years considered for the estimation purpose.

4.2.4 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 7 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 FINANCIAL INDICATORS

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 10 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

The project is expected to achieve monetary savings of Rs. 105.82 lacs.

- The Operation and Maintenance cost is estimated at 2% of cost of total project with 5% increase in every year as escalations.
- Interest on term loan is estimated at 10%.
- Depreciation is provided as per the rates provided in the companies act.

Considering the above mentioned assumptions, the net cash accruals starting with Rs. 70.33 lakh in the first year operation and to Rs. 455.78 lakh at the end of tenth year.

.4.3.2 Simple payback period

The estimated payback period is about 2.34 years or about 28 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be Rs. 214.90 lakh.

4.3.4 Internal rate of return (IRR)

The after tax IRR of the project works out to be 29.98%. Thus the project is financially viable for both types of fuels.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 22.43%. Financial indicator of proposed technology is furnished in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology/equipment

SN	Scenario	IRR	NPV	ROI	DSCR
1	Normal	29.98%	214.90	22.43	2.20

4.4 SENSITIVITY ANALYSIS

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations like when there is an increase in fuel savings or decrease in fuel savings. For the purpose of sensitive analysis, two following scenarios has been considered

- Optimistic scenario (Increase in energy savings by 5%)
- Pessimistic scenario (Decrease in energy savings by 5%)

In each scenario, other inputs are assumed as a constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Details of sensitivity analysis at different scenarios are shown in Table 4.3 below:

Table 4.3 Sensitivity analysis at different scenarios

Sr. No.	Scenario	IRR	NPV	ROI	DSCR
1	Normal	29.98%	214.90	22.43	2.20
2	5% Increase in Fuel Saving	31.97%	237.99	22.59	2.31
3	5% Decrease in Fuel Saving	27.97%	191.80	22.25	2.09

4.5 PROCUREMENT AND IMPLEMENTATION SCHEDULE

Procurement and implementation schedule for proposed project is of 18 weeks out of which 16 weeks are for placement of orders and delivery shown in Table 4.4 below and further details of process break down are shown in Annexure 6.

Table 4.4 Procurement and implementation schedule

SN	Activities	Weeks				
		1	-	16	17	18
1	Order Placement					
2	Delivery					
3	Foundation & civil work					
4	Pipeline Modification					
5	Cabling & electrical panel fitting					
6	Testing and trial					
7	On site operator training					

Annexure

Annexure -1: Energy audit data used for baseline establishment

Sr. No.	Unit	Installed HP	Working HP
1.	Sludge pumps for clarifier 'A'	4.0	2.0
2.	Clarifier Mechanism	1.0	1.0
3.	Nutrients dosing system	2.0	2.0
4.	Surface aerator for aeration tank	120.0	120.0
	Total	127HP / 95.25 kW	125 HP / 93.75 kW

Along with loss of methane as fuel, about 10 to 15 kW actual excess electricity is consumed in existing system.

Annexure -2: Process flow diagram after project implementation

There is no change in process flow diagram after implementation of methane capture project.The process flow will not change. The only change will be the ammonia compressor will be provided with Energy Efficient Electric Motor.

Annexure -3: Detailed technology assessment report

"Apart from methane capture, which will be used as fuel, methane capture system provides a unique solution to any of the following energy management problems:

- Reduction of installed power
- Benefit to environment.
- Optimization of electrical resources.
- Energy management (both electrical & thermal fuel saving)
- Increase system reliability
- Back-up function"

The details of cost benefit analysis are as given below –

Untreated Effluent Data			
S.no.	**Parameter**	**Unit**	**Value**
1)	BOD	mg/Ltrs	2500
2)	COD	mg/Ltrs	5000
3)	Effluent Quantity	Ltrs/Hr	41666
Calculations for Bio-gas Generation			
1)	COD Load per Day	Kg/Day	5000
2)	COD Reduction Percentage Considered	%	80
3)	Actual Reduced COD Load	Kg/Day	4000
4)	Bio-gas (Methane) Generated	m^3/Kg of Reduced COD Load	0.5
5)	Thus Actual Bio-Gas Generated	m^3/Day	2000
6)	Calorific Value of Bio-Gas	Kcal/m^3	4900
7)	Total heat that can be generated from Bio-gas	Kcal/Day	9800000
8)	Calorific Value of FO	Kcal/Ltrs	10000
9)	FO Equivalent of Bio-gas Generated	Ltrs/Day	980
9)	Total FO Equivalent of Bio-gas Generated per Annum	Ltrs /annum	352800
10)	Cost of FO	Rs./Ltrs	29
11)	Saving from Bio-gas Generation	Rs./Day	28420
	Additional Saving of Electricity By anaerobic treatment instead of Aerobic Treatment	kWh/annum	54000
11)	Cost of electricity	Rs./ kWh	6.49
12)	Total Saving in Rupees per annum due to anaerobic treatment per annum	Rs./Annum	350460
13)	No. of Working Days/Annum	Days	360
14)	Total Expected Saving per Annum	Rs./Annum	10581660
15)	Expected KLOE Saving Per Annum	KLOE/Annum	2025

16)	Expected Investment for Civil Work, Mechanical Works, electrical works etc	Rs.	24756000
17)	Simple Payback Period	Yrs	2.34
		Months	28
18)	Expected FO Equivalent Saved per Annum	Liter/Annum	352800

***** (1 Kg=1000000 mg & Considering for ETP, 1Kg=1Ltr)***

Electrical saving Description

SN	DPR Particulars	Power Saving in Connected HP	Power Saving in Actual kWh (Considering 85% Load)	Hrs of Operation per day	Working Days	Total kWh Saving
1	1000 Cumec Methane Capture	10	6.3	24	360	54000

Annexure -4 Drawings for proposed electrical & civil works

No additional electrical system will be required. Even electrical load as mentioned above will be reduced so there will be no change in electrical diagram. The drawing of civil work has been provided as per the scheme.

Annexure -5: Detailed financial analysis

Name of the Technology		METHANE CAPTURE FROM DAIRY EFFLUENT	
Rated Capacity			**1000 m³/Day Capacity**
Details	**Unit**	**Value**	**Basis**
Installed Capacity	m³/Day	1000	
No of working days	Days	360	
No of Shifts per day	Shifts	3	
Proposed Investment			
Plant & Machinery	Rs. (in lakh)	145	
Civil Work		80	
Erection & Commissioning	Rs. (in lakh)	20	
Investment without IDC	Rs. (in lakh)	245	
Misc. Cost	Rs. (in lakh)	2.56	
Total Investment	Rs. (in lakh)	247.56	
Financing pattern			
Own Funds (Equity)	Rs. (in lakh)	61.89	Feasibility Study
Loan Funds (Term Loan)	Rs. (in lakh)	165.67	Feasibility Study
Loan Tenure	Years	7.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	90.00	Assumed
Interest Rate	%age	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	2.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity Saving	kWh/Year	54000	
Cost of electricity	Rs./kWh	6.49	
Furnace oil saving	Kg/Annum	352800	
Cost	Rs./kg	29	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan **Rs. (in lakh)**

Years	Opening Balance	Repayment	Closing Balance	Interest
1	185.67	9.00	176.67	21.53
2	176.67	18.00	158.67	16.85
3	158.67	24.40	134.27	14.77
4	134.27	26.80	107.47	12.22
5	107.47	28.90	78.57	9.46
6	78.57	30.10	48.47	6.57
7	48.47	31.60	16.87	3.48
8	16.87	16.87	0.00	0.50
		185.67		

WDV Depreciation **Rs. (in lakh)**

Particulars / years	1	2
Plant and Machinery		
Cost	247.56	49.51
Depreciation	198.05	39.61
WDV	49.51	9.90

Projected Profitability **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Fuel savings	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82
Total Revenue (A)	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82	105.82
Expenses										
O & M Expenses	4.95	5.20	5.46	5.73	6.02	6.32	6.64	6.97	7.32	7.68
Total Expenses (B)	4.95	5.20	5.46	5.73	6.02	6.32	6.64	6.97	7.32	7.68
PBDIT (A)-(B)	100.87	100.62	100.36	100.08	99.80	99.50	99.18	98.85	98.50	98.14
Interest	21.53	16.85	14.77	12.22	9.46	6.57	3.48	0.50	0.00	0.00
PBDT	79.33	83.77	85.59	87.86	90.34	92.93	95.70	98.35	98.50	98.14
Depreciation	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07
PBT	66.26	70.70	72.51	74.79	77.27	79.86	82.63	85.28	85.43	85.06
Income tax	0.00	15.01	29.09	29.86	30.71	31.59	32.53	33.43	33.48	33.36
Profit after tax (PAT)	66.26	55.69	43.42	44.93	46.56	48.27	50.10	51.85	51.95	51.71

Computation of Tax **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Profit before tax	66.26	70.70	72.51	74.79	77.27	79.86	82.63	85.28	85.43	85.06
Add: Book depreciation	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07
Less: WDV depreciation	198.05	39.61	-	-	-	-	-	-	-	-
Taxable profit	118.72	44.16	85.59	87.86	90.34	92.93	95.70	98.35	98.50	98.14
Income Tax	-	15.01	29.09	29.86	30.71	31.59	32.53	33.43	33.48	33.36

Projected Balance Sheet **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Share Capital (D)	61.89	61.89	61.89	61.89	61.89	61.89	61.89	61.89	61.89	61.89
Reserves & Surplus (E)	66.26	121.95	165.37	210.30	256.86	305.14	355.24	407.08	459.03	510.74
Term Loans (F)	176.67	158.67	134.27	107.47	78.57	48.47	16.87	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	304.82	342.51	361.53	379.66	397.32	415.50	434.00	468.97	520.92	572.63

Assets	1	2	3	4	5	6	7	8	9	10
Gross Fixed Assets	247.56	247.56	247.56	247.56	247.56	247.56	247.56	247.56	247.56	247.56
Less Accm. Depreciation	13.07	26.14	39.21	52.28	65.36	78.43	91.50	104.57	117.64	130.71
Net Fixed Assets	234.49	221.42	208.35	195.28	182.20	169.13	156.06	142.99	129.92	116.85
Cash & Bank Balance	70.33	121.09	153.19	184.38	215.12	246.36	277.93	325.98	391.00	455.78
TOTAL ASSETS	304.82	342.51	361.53	379.66	397.32	415.50	434.00	468.97	520.92	572.63
Net Worth	128.15	183.84	227.26	272.19	318.75	367.03	417.13	468.97	520.92	572.63
Debt Equity Ratio	2.85	2.56	2.17	1.74	1.27	0.78	0.27	0.00	0.00	0.00

Projected Cash Flow **Rs. (in lakh)**

Particulars / Years	0	1	2	3	4	5	6	7	8	9	10
Sources											
Share Capital	61.89	-	-	-	-	-	-	-	-		
Term Loan	185.7										
Profit After tax		66.26	55.69	43.42	44.9	46.6	48.27	50.1	51.85	51.95	51.71
Depreciation		13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1	13.1
Total Sources	247.6	79.33	68.76	56.50	58.0	59.6	61.34	63.2	64.92	65.02	64.78
Application											
Capital Expenditure	247.6										
Repayment Of Loan	-	9.00	18.00	24.40	26.8	28.9	30.10	31.6	16.87	0.00	0.00
Total Application	247.6	9.00	18.00	24.40	26.8	28.9	30.10	31.6	16.87	0.00	0.00
Net Surplus	-	70.33	50.76	32.10	31.2	30.7	31.24	31.6	48.05	65.02	64.78
Add: Opening Balance	-	-	70.33	121.1	153.2	184.4	215.1	246.4	277.9	325.9	391.0
Closing Balance	-	70.33	121.1	153.2	184.4	215.1	246.4	277.9	325.9	391.0	455.8

IRR & NPV **Rs. (in lakh)**

Particulars / months	0	1	2	3	4	5	6	7	8	9	10
Profit after Tax		66.26	55.69	43.42	44.93	46.6	48.27	50.10	51.85	51.95	51.71
Depreciation		13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07
Interest on Term Loan		21.53	16.85	14.77	12.22	9.46	6.57	3.48	0.50	-	-
Cash outflow					-	-	-	-	-	-	-
Net Cash flow	247.56	-	-	-	-	-	-	-	-	-	-
IRR	29.98%										

NPV	214.90

Break Even Point **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10
Variable Expenses										
Oper. & Maintenance Exp	3.71	3.90	4.09	4.30	4.51	4.74	4.98	5.23	5.49	5.76
Sub Total(G)	3.71	3.90	4.09	4.30	4.51	4.74	4.98	5.23	5.49	5.76
Fixed Expenses										
Oper. & Maintenance Exp	1.24	1.30	1.36	1.43	1.50	1.58	1.66	1.74	1.83	1.92
Interest on Term Loan	21.53	16.85	14.77	12.22	9.46	6.57	3.48	0.50	0.00	0.00
Depreciation (H)	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07
Sub Total (I)	35.84	31.22	29.21	26.73	24.03	21.22	18.21	15.32	14.90	14.99
Sales (J)	105.8	105.8	105.8	105.8	105.8	105.8	105.8	105.8	105.8	105.8
Contribution (K)	102.10	101.92	101.72	101.52	101.30	101.08	100.84	100.59	100.33	100.06
Break Even Point (L= G/I) %	35.11	30.63	28.71	26.33	23.72	20.99	18.06	15.23	14.85	14.98
Cash Break Even {(I)-(H)}%	22.30	17.81	15.86	13.45	10.82	8.06	5.10	2.23	1.82	1.92
Break Even Sales (J)*(L)	37.15	32.41	30.38	27.86	25.10	22.21	19.11	16.11	15.71	15.85

Return on Investment **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Net Profit Before Taxes	66.26	70.7	72.51	74.79	77.27	79.86	82.63	85.28	85.43	85.06	779.80
Net Worth	128.15	183.84	227.26	272.19	318.75	367.03	417.13	468.97	520.92	572.63	3476.87
											22.43%

Debt Service Coverage Ratio **Rs. (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	9	10	Total
Cash Inflow											
Profit after Tax	66.26	55.69	43.42	44.93	46.56	48.27	50.10	51.85	51.95	51.71	407.08
Depreciation	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	13.07	104.57
Interest on Term Loan	21.53	16.85	14.77	12.22	9.46	6.57	3.48	0.50	0.00	0.00	85.38
Total (M)	100.87	85.61	71.27	70.22	69.09	67.91	66.65	65.42	65.02	64.78	597.04

DEBT

Interest on Term Loan	21.53	16.85	14.77	12.22	9.46	6.57	3.48	0.50	0.00	0.00	85.38
Repayment of Term Loan	9.00	18.00	24.40	26.80	28.90	30.10	31.60	16.87	0.00	0.00	185.67
Total (N)	30.53	34.85	39.17	39.02	38.36	36.67	35.08	17.37	0.00	0.00	271.05
	3.30	2.46	1.82	1.80	1.80	1.85	1.90	3.77	0.00	0.00	2.20
Average DSCR (M/N)	2.20										

Annexure:-6 Procurement and implementation schedule

Week wise break up of implementation Schedule

SN	Activities	Weeks				
		1	-	16	17	18
1	Order Placement					
2	Delivery					
3	Foundation & civil work					
4	Pipeline Modification					
5	Cabling & electrical panel fitting					
6	Testing and trial					
7	On site operator training					

The proposed system is anaerobic treatment (methane capture) against existing aerobic treatment. The existing system is almost fully utilized in proposed system with downgrading electric motor as per DPR (Pl refer Flow chart of both existing & proposed system). The construction of UASB, gas holder etc additional item will be first done along with provision of pipe fittings, pumps etc. Till these are ready, the existing system will not be stopped to reduce the down time. Once the additional system required is constructed & installed, the integration of proposed system with existing system will require 14 days.

The break up is as follow –

a. Pipe line modification for integration of additional system such as UASB, gas holder etc will require 7 days.

b. Additional Civil constructed channels for effluent flow along with curing will require 7 days (simultaneous with above activity)

c. Minor modifications in primary clarifier for fat trap etc 5 Days (simultaneous with above activity)

d. Making by pass arrangement for aerator to deal with future maintenance 5 Days (simultaneous with above activity)

e. Installing electric motors, electric panels, electric starters, distribution box etc for additional electric motors. Downgrading the existing aerator system (as proposed system saves energy in portion of existing system) will require 2 days (After completion of first 7 day phase of above installation work)

f. Trial of newly constructed tanks, gas holder etc by filling water (full load test) (Simultaneously with above 3 days)

g. Cleaning and detailed inspection of entire system for mechanical joints, electrical system, pumps etc will require 3 days (After completion of above phase)

h. Final complete trial of 1000 cumec effluent methane captures 2 days.

i. Contingency considered for above complete operation 1 day.

Overall out of total two weeks required first week will be required for installation & erection while second week will be required for electrification, testing, trial etc.

Annexure -7: Details of technology service providers

S.No.	Name of Service Provider	Address	Contact Person and No.
1	**Sun Enviro Technologies Pvt. Ltd.,**	178, Chhatrapati Nagar, Wardha Road, Nagpur - 440 015 Maharashtra, India	Mr. Utkarsh Khopkar Mobile Number :- 09423686051
2	**Energy Options Incorporation**	216, Krishna Con-Arch 2, Tagore Road, Godown Road Corner, Rajkot – 360002, Gujarat	Mr. Jagdish Langewar Mobile :-09422102926
3	**Bio Energy Engineering**	MLS Business Centre, Panchasheel Tech Park, Hinjewadi, Pune – 57; Maharashtra	Mr. Shirish Dhamnekar Mobile Number :- 09819077387

Annexure–8: Quotations or Techno-commercial bids for new technology/equipment

Sun Enviro Technologies Pvt.Ltd.
178, CHHATRAPATI NAGAR,
NAGPUR – 440 015, MAHARASHTRA, INDIA
Phone: 91-712-2282608
Fax No. 91-712-2282888
Email: sunenviro@hotmail.com
Website: www.sunenv.com

Ref. No. : PR/ETP/2011/110
Date : March 15, 2011

To,
PETROLEUM CONSERVATION RESEARCH ASSOCIATION
AHMEDABAD CHAPTER

Kind Attn: Lt. Vijay Kumar Bariwal - Asst. Director
Mr. Shashibhushan S Agrawal - Energy Auditor

Subject: Proposal for "Methane Capture Project" at Sabar Dairy
Ref : Our preliminary proposal during energy audit conducted in 2010
Information dissemination Workshop held on 11th March 2011

Dear Sir,
This has reference above documents and our visit to Sabar dairy during first phase of this project.

We are pleased to submit our detailed proposal based on details collected during our visit to plant site for "Methane Capture Project"

We wish to state that we have the necessary expertise, manpower and other resources to carryout this work for you to your entire satisfaction.

We hope our offer is in line with your requirement in case you need any clarification/information please feel free to contact us.

Thanking you,

Yours Sincerely
For **SUN ENVIRO TECHNOLOGIES PVT. LTD.,**

Utkarsh Khokar
Mobile 9423686051

Sun Enviro Technologies Pvt. Ltd.
178, Chhatrapati Nagar, Nagpur
440 015, Maharashtra, India
Phone: 91-712-2282608
Fax No. 91-712-2282888
Email: sunenviro@sunenv.com

CUSTOMER:	PCRA/BEE	TECHNICAL SPECIFICATIONS AND PROPOSAL FOR METHANE CAPTURE PROJECT	Quotation No.	PR/ETP/2011/110
END USER:	SABAR DAIRY		DATE:	15/03/2011
PROJECT:	METHANE CAPTURE		ITEM NAME	BIO DIGESTER

7. COMMERCIAL

PRICE SCHEDULE

Item	Rs.
Civil Works	80,00,000=00
Mechanical Equipments	41,50,000=00
Electrical Equipments	5,50,000=00
Interconnecting Piping and Valves	8,50,000=00
Site Fabrication work (Including Structural steel & M.S. Plates, FRP Coating)	75,00,000=00
Anti corrosive painting	5,00,000=00
Drawing designing & commissioning	9,50,000=00
Total	**2,25,00,000=00**

(Rupees Two Crores Twenty Five Lacks Only.)

CIVIL COST IS BASED ON THE FOLLOWING ASSUMPTIONS:

a. Safe bearing capacity at site at 1 m depth – 10 MT/Sq. M.

b. Water table considered below 4-m depth.

c. Construction water free of cost at site.

d. Electricity for construction use free of cost.

Sun Enviro Technologies Pvt. Ltd.
178, Chhatrapati Nagar, Nagpur
440 015, Maharashtra, India
Phone: 91-712-2282608
Fax No. 91-712-2282888
Email: sunenviro@sunenv.com

CUSTOMER:	PCRA/BEE	TECHNICAL SPECIFICATIONS AND PROPOSAL FOR METHANE CAPTURE PROJECT	Quotation No.	PR/ETP/2011/110
END USER:	SABAR DAIRY		DATE:	15/03/2011
PROJECT:	METHANE CAPTURE		ITEM NAME	BIO DIGESTER

7. UTILITY REQUIREMENT

A) Power requirement

Sr. No.	Unit	Installed HP	Working HP
1.	Feed Pumps for UASB	10	7
2.	Sludge pumps for clarifier 'A'	4.0	2.0
3.	Clarifier Mechanism	1.0	1.0
4.	Blowers for pre aeration tank	10.0	5.0
5.	Bio-Gas Blowers	6.0	3.0
6.	Feed pump for aeration	10.0	5
7.	Nutrients dosing system	2.0	2.0
	Total	**43HP / 32.06 Kw**	**25 HP / 18.64 Kw**

NOTE : IN CASE ONLY AERATION IS USED FOR TREATMENT OF 1000 M3/DAY WASTE WATER , POWER REQUIREMENT WILL BE 35 HP

IN COMBINED SYSTEM (ANAROBIC +AEROBIC) POWER REQUIREMENT WILL BE 25 HP

HENCE TOTALSAVING IN POWER WILL BE 10 HP PER HOUR.

B) Manpower required

Plant In- charge / Chemist	1 person
Operators	1 Person / shift
Helper	2 person / shift

C) Chemical and Nutrients

Following chemicals shall be required during commissioning and steady state operation of the plant. Exact qty will be determined during the commissioning of ETP.

1. Urea
2. DAP
3. Lime – as per process requirement
4. Sodium Bi Carbonate
5. For anaerobic treatment, Anaerobic sludge/cow dung will be required around 50,000 liters at the start of commissioning.

Sun Enviro Technologies Pvt. Ltd.
178, Chhatrapati Nagar, Nagpur
440 015, Maharashtra, India
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Email: sunenviro@sunenv.com

CUSTOMER:	PCRA/BEE	TECHNICAL SPECIFICATIONS AND PROPOSAL FOR METHANE CAPTURE PROJECT	Quotation No.	PR/ETP/2011/110
END USER:	SABAR DAIRY		DATE:	15/03/2011
PROJECT:	METHANE CAPTURE		ITEM NAME	BIO DIGESTER

Terms & Conditions

ORDER CONFIRMATION — All orders placed on us will be binding only after receipt of a Order, Advance Payment and issue of our Order Acceptance.

PRICE BASIS — All prices quoted are Ex works, Nagpur exclusive of:

- Duties, Taxes and Octroi or any other levies
- Freight, Transit Insurance and Packing & Forwarding
- Central Excise and other levies applicable at the time of dispatch.

SALES TAX — As applicable at the time of dispatch.

- Current rate is 2% against form C.
- VAT is 12.5% for Maharashtra Sales.

EXCISE DUTY — N.A.

SERVICE TAX — Extra on consultancy services presently 10.30%

PACKING AND FORWARDING — Included

FREIGHT, TRANSIT INSURANCE AND OCTROI

- All Equipment will be dispatched on FREIGHT TO PAY basis.
- Shipment details will be given to the Purchaser for arranging Transit Insurance.
- Octroi if applicable will be paid by the Purchaser.

TERMS OF PAYMENT FOR SUPPLY OF EQUIPMENTS

- 30% of Total Order Value as advance along with Order.
- 65% of Total Order Value along with applicable taxes against Proforma Invoice before dispatch
- 5% of total Order value against commissioning of ETP.

FOR CONSULTANCY SERVICES

- 30% advance at the time of placement of order.
- 50% after submission and approval of drawings.
- 10% after physical completion of the plant.
- 10 % after successful commissioning of the plant.

Sun Enviro Technologies Pvt. Ltd.
178, Chhatrapati Nagar, Nagpur
440 015, Maharashtra, India
Phone: 91-712-2282608
Fax No. 91-712-2282888
Email: sunenviro@sunenv.com

CUSTOMER:	PCRA/BEE	TECHNICAL SPECIFICATIONS AND PROPOSAL FOR METHANE CAPTURE PROJECT	Quotation No.	PR/ETP/2011/110
END USER:	SABAR DAIRY		DATE:	15/03/2011
PROJECT:	METHANE CAPTURE		ITEM NAME	BIO DIGESTER

VALIDITY OF OFFER

- 30 days from the date of Offer.

DELIVERY PERIOD

- Delivery of the equipment will be 16 weeks ex our works.
- The delivery period will begin after receipt of technically and commercially clear Order and Advance.
- Any changes required by the Purchaser after the drawings have been approved or after the commencement of manufacturing activities may result in the delivery period being extended. All additional charges incurred including engineering man days will be borne by the Purchaser.
- In case of Third Party Inspection delivery period will be extended by 2 weeks.

INSPECTION

- All our equipment are subjected stringent Quality Control tests prior to despatch.
- If mutually agreed during order finalization the equipment shall be offered for visual inspection at our works.
- If the Inspector nominated by the Purchaser requires to stay overnight his lodging and boarding charges shall be bear by purchaser.
- The date of inspection will be given 15 days in advance. If the Purchaser fails to carry out inspection by the date advised by us, we shall be free to dispatch the equipment.

WARRANTY

- The equipment is guaranteed for faulty design, material or workmanship for a period of 18 months from the date of dispatch or 12 months from the date of commissioning whichever is earlier.

DISPATCH

- In case we do not receive the payment within 30 days of date of Proforma Invoice we will be forced to consider the order as cancelled and all the advance payment received against it will be forfeited.
- Sun Enviro Technologies Pvt. Ltd., reserves the right to divert the equipment if the Purchaser fails to fulfil the contractual obligations within the stipulated time frame.

Sun Enviro Technologies Pvt. Ltd.
178, Chhatrapati Nagar, Nagpur
440 015, Maharashtra, India
Phone: 91-712-2282608
Fax No. 91-712-2282888
Email: sunenviro@sunenv.com

CUSTOMER:	PCRA/BEE	TECHNICAL SPECIFICATIONS AND PROPOSAL FOR METHANE CAPTURE PROJECT	Quotation No.	PR/ETP/2011/110
END USER:	SABAR DAIRY		DATE:	15/03/2011
PROJECT:	METHANE CAPTURE		ITEM NAME	BIO DIGESTER

COMMISIONING

- All assistance like unskilled manpower , consumables, chemicals required during commissioning will be provided by the Purchaser.
- The Purchaser will provide for Lodging and boarding of our site engineer / commissioning engineer in an air-conditioned company guest house or equivalent hotel.

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
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Websites: www.bee-india.nic.in, www.energymanagertraining.com

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