August 2018

DETAILED PROJECT REPORT ON 40 kW BIO GAS POWER GENERATION

M/s Sarhad Dairy, Bhuj– Gujarat Dairy Cluster

Submitted to
(Prepared under GEF-UNIDO-BEE Project)

Bureau of Energy Efficiency
4th Floor, Sewa Bhawan, Sector – 1, R. K. Puram, New Delhi - 110066

Prepared by

Confederation of Indian Industry
CII – Sohrabji Godrej Green Business Centre
Survey No. 64, Kothaguda Post, Near HITEC City
Hyderabad 500064

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List of Abbreviations

BEE	Bureau of Energy Efficiency
BOD	Biological Oxygen Demand
CS	Capital Structure
°C	°Celsius
CFM	Cubic Feet Minute
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
DPR	Detailed Project Report
EE	Energy Efficiency
ETP	Effluent Treatment Plant
FI	Financial Institution
GCMMF	Gujarat Cooperative Milk Marketing Federation
GEF	Global Environmental Facility
IRR	Internal Rate of Return
kJ	Kilo Joule
KLPD	Kilo Litres Per Day
kW	Kilo Watt
LSP	Local Service Provider
MSME	Micro and Medium Scale Industries
NPV	Net Present Value
OEM	Original Equipment Manufacturer
RE	Renewable Energy
SBI	State Bank of India
SIDBI	Small Industrial Development Bank of India
TOE	Tonnes of Oil Equivalent
UASB	Uplflow Anaerobic Sludge flow Blank
UNIDO	United Nations Industrial Development Organisation
WACC	Weighted Average Cost of Capital

ACKNOWLEDGEMENT

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We would also like to mention that the valuable efforts being taken and the enthusiasm displayed towards energy conservation by the Gujarat Dairy Cluster is appreciable and admirable.

1. EXECUTIVE SUMMARY

Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, in collaboration with United Nations Industrial Development Organization (UNIDO) is executing a Global Environment Facility (GEF) funded national project "Promoting energy efficiency and renewable energy in selected MSME clusters in India".

The overall aim of the project is to develop and promote a market environment for introducing energy efficiency and enhanced use of renewable energy technologies in process applications in 12 selected energy-intensive MSME clusters across 5 sectors in India (with expansion to more clusters later). This will enable improvement in the productivity and competitiveness of units, as well as reduce overall carbon emissions and improve the local environment.

Key activities involved in the project are shown below

- **LSP MAPPING:** Detailed Mapping of LSPs in the cluster.
- **TECHNOLOGY FEASIBILITY STUDIES:** Preparation of 10 bankable DPRs.
- **TRAINING MATERIALS:** Development of 5 customized training material based on mapping
- **TRAINING PROGRAM:** Conduct 4 training programs in the cluster for the capacity building of local service providers.
- **LSP's AS LOCAL DISTRIBUTORS:** Mapping of LSPs and OEMs so that LSPs can be local dealers for major OEMs.

1.1 Brief Unit Profile

Table 1: Unit Details

Particulars	Details
Name of Plant	Sarhad Dairy
Name(s) of the Plant Head	Mr. Nilesh Jalamkar
Contact person	Mr. Hardik Kataria
Constitution	Cooperative Society
MSME Classification	Large Scale
Address:	S.R. No 208, Lakhond Village, Bhuaj Bhachau Highway, Bhuj
Industry-sector	Dairy

1.2 Proposed EE Measure

After the discussion with the plant team, it has been decided to install bio gas engine with 40 kW bio gas generator for the ETP plant. The details of the proposed EE measure is given in below table:

Table 2: Proposed EE Measure

Sl No	EE Measure	Annual Energy Savings		Monetary Savings (Rs. Lakhs)	Investment (Rs. Lakhs)	Payback (Months)	Annual TCO_2 reduction
		kWh	TOE				
1	40 kW Bio Gas Power Generation	2,51,989	21.67	16.13	31.86	24	206.63

1.3 Means of Finance

The details of means of finance for the proposed EE measure is as under:

Table 3; Project Finance

Sl. No.	Particulars	Unit	Value
i	Total Investment (Incl of Tax)	Rs. Lakh	**31.86**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**71.44**
Iv	NPV at 70 % Debt	Rs. Lakh	**67.14**

2. INTRODUCTION ABOUT SARHAD DAIRY

2.1 Unit Profile

Kutch district co-operative milk producer's union ltd."Sarhad dairy" was established in year 2009. Sarhad dairy is the member of "GCMMF" AMUL Anand. Its primary activity is collecting milk from village co-operative societies, processing milk and make product under the brand name of "AMUL". In the beginning Union was collecting milk from the 17 village co-operative societies but now Sarhad Dairy is collecting milk from more than 550 village co-operative societies locating in Kutch district which is supplying milk to dairy's chilling centers and dairy is collecting milk from dairy's own various chilling centers located in the Kutch district.

In the month of January 2013 Sarhad Dairy has started processing plant at- Lakhond, Taluka – Bhuj - Kutch processing milk and making milk pouch under the brand name of "AMUL" currently it has capacity of 2 Lakh litres per day.

Table 4: Unit Profile

Particulars	Details
Name of Plant	Sarhad Dairy
Name(s) of the Plant Head	Mr. Nilesh Jalamkar
Contact person	Mr. Hardik Kataria
Contact Mail Id	hardik@sarhaddairy.coop
Contact No	09687655965
Constitution	Cooperative Society
MSME Classification	SME
No. of years in operation	7
No of operating hrs/day	24
No of operating days/year	365
Address:	S.R. No 208, Lakhond Village, Bhuaj Bhachau Highway, Bhuj
Industry-sector	Dairy
Type of Products manufactured	Milk ,Ghee, Dahi

2.2 Production Details

The various products manufactured in Sarhad dairy are liquid milk, ghee, dahi. The graph shows the milk processed during last one year.

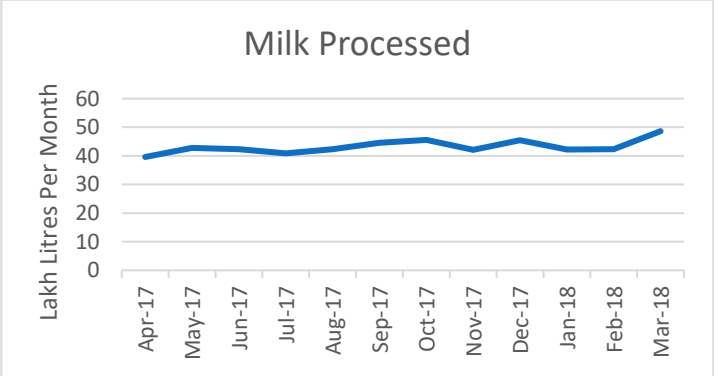

Figure 1: Milk Processed

2.3 Typical Dairy Process Flow Diagram

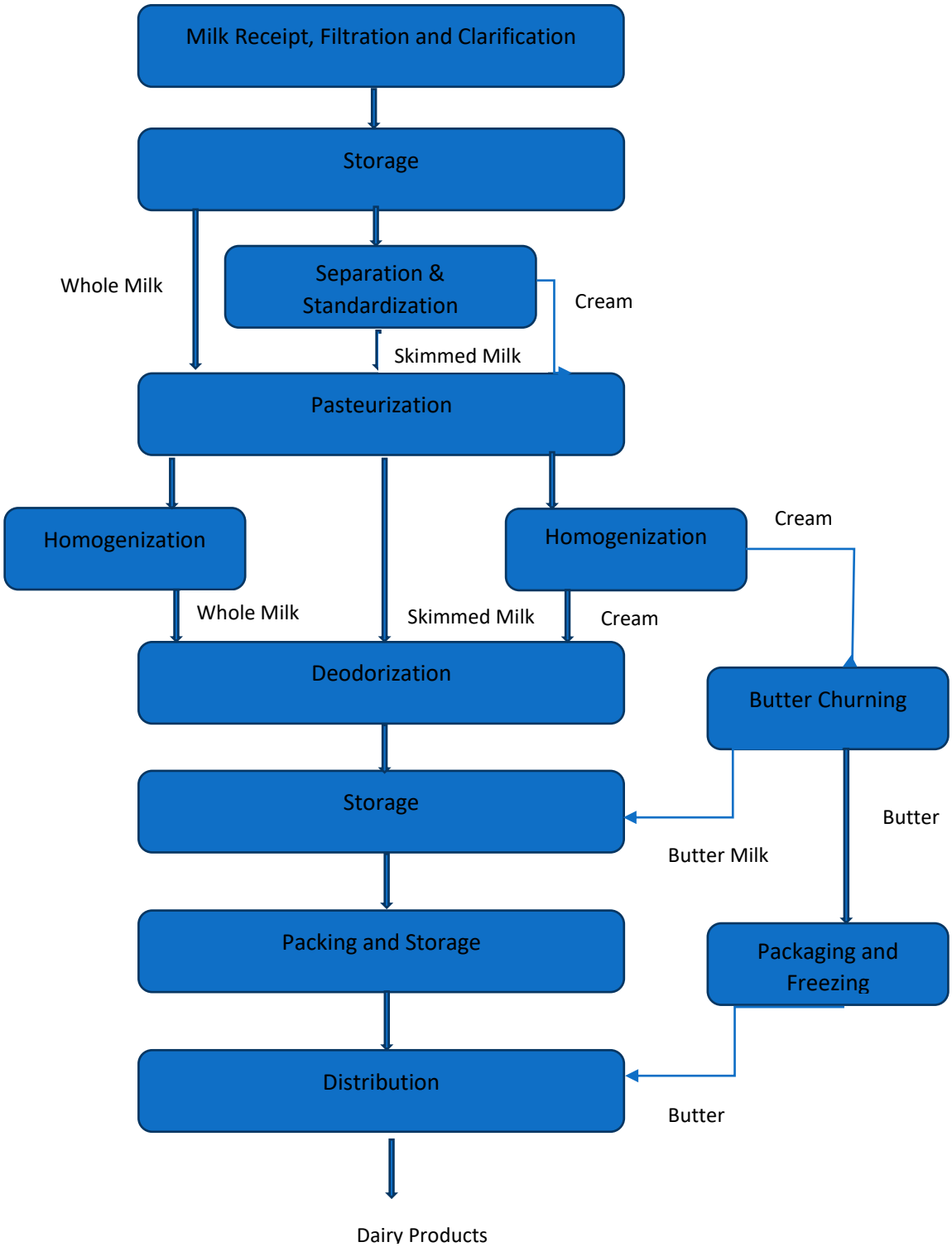

Figure 2: Typical process flow of Milk manufacturing

The processes taking place in a typical milk plant after receiving and filtration of milk from the chilling units includes:

Separation: After being held in storage tanks at the processing site, raw milk is heated to separation temperature in the regeneration zone of the pasteurizer. The milk (now hot) is standardized and homogenized by sending it to a centrifugal separator where the cream fraction is removed. The skim is then usually blended back together with the cream at predefined ratios so that the end product has the desired fat content. Surplus hot cream is cooled and usually processed in a separate pasteurizer ready for bulk storage and transportation to a cream packing plant.

Pasteurization is a process of heating milk to 72°C for 16 seconds then quickly cooling it to 4°. This process slows spoilage caused by microbial growth in the food. Unlike sterilization, pasteurization is not intended to kill all micro-organisms in the food. Instead, it aims to reduce the number of viable pathogens so they are unlikely to cause disease.

Homogenization (if required): 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

Packaging and storage: 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 fresh.

The table below shows the production capacity of various section in plant daily

Table 5: Production Capacity

Sl No	Product	UOM	Quantity
1	Milk Processing	Lakh Litres per Day	2
2	Milk Packaging in Poly Pouches	Lakh Litres per Day	2
3	Ghee Manufacturing and Packaging	MT/day	4
4	Dahi Milk Product	MT/day	7.5

2.3 Energy Profile

Both electricity and thermal energy are used for carrying out various dairy processing activities. The following fuels are used in the plant:-

Table 6: Type of fuel used

Sl. No.	Type of fuel/Energy used	Unit	Tariff	GCV
1	Electricity	Rs./kWh	6.40	
2	Briquette	Rs/kg	5.00	4500 (kCal/kg)

The steam cost in the plant is Rs 1.48/kg. The table below shows the monthly consumption of various fuels used in the plant during the last one year

Table 7: Fuel Consumption Details

Month	Electricity Consumption (kWh)	Fuel Consumption – Briquette (kg)
Apr-17	2,36,656	1,20,000
May-17	2,75,442	1,25,000
Jun-17	2,78,326	1,22,300
Jul-17	2,53,736	1,25,000
Aug-17	2,46,432	1,23,000
Sep-17	2,64,495	1,30,000
Oct-17	2,73,958	1,34,000
Nov-17	2,30,471	1,38,000
Dec-17	2,28,648	1,34,000
Jan-18	2,28,816	1,37,000
Feb-18	2,09,616	1,45,000
Mar-18	2,49,480	1,43,000
Total	**17,63,518**	**15,76,300**

The major form of energy used in the plant is electricity which is from grid. For thermal ,plant is using Briquette as the major fuel. The percentage share of fuel cost is shown below:-

Based on the data collected from the plant, the graph above shows the variation of fuel cost over the last one year. Average electricity cost is Rs 15.87 Lakhs/month whereas the average thermal energy cost is Rs 6.56 Lakhs/month.

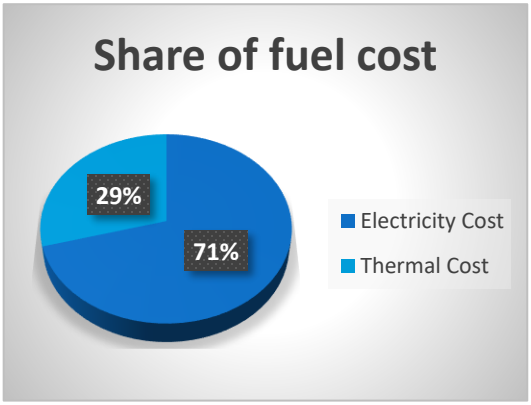

Figure 3: Share of fuel cost

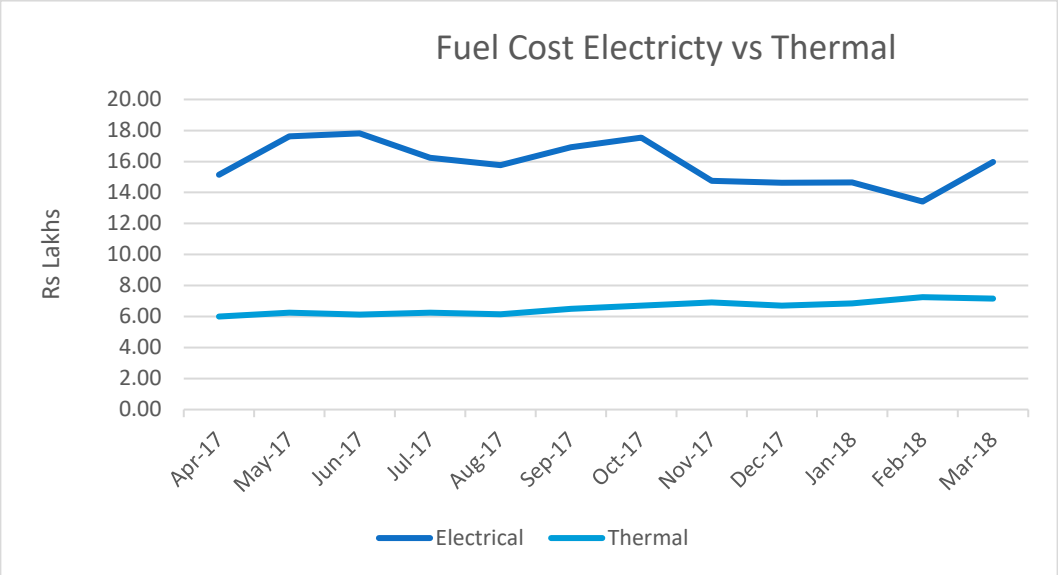

Figure 4: Fuel Cost Electrical vs Thermal

3. PROPOSED EE MEASURE – 40 kW Bio Gas Power Generation

3.1 Present System

Sarhad dairy has installed a 300 KLPD ETP plant to treat the effluents from various processes. In dairy effluent treatment plants, effluents generated from various sections of the production facilities are first received in a collection tank. Before mixing in an equalization tank, the effluents are passed through a fat trap unit. The low-density semi-solids, which float in the tank and contain fats, proteins, packing materials, etc., are known as 'dairy effluent scum' and are removed manually. After removing the dairy effluent scum (top layer), the effluents are further treated in aerobic or anaerobic conditions. The characteristics of dairy effluent scum vary with the products being produced in the plant and their relative proportion and the methods of the operation used.

The ETP contains following unit processes / operations:

- Equalization tank for collection of raw effluent generated from plant for homogenization of the quantity and quality.
- Anaerobic biological treatment for removal of most of the suspended and dissolved organic impurities – It includes an Up Flow Anaerobic Sludge Blanket Reactor followed by a settling tank.
- Aerobic biological treatment unit for polishing of aerobically treated effluent to achieve statutory disposal norms – It includes an Aeration Tank followed by a Settling tank.
- Polishing treatment units: for further purification of treated effluent - It includes a duel media pressure filter, an Activated Carbon Filter, a Micron Filtration System, an Ultra-filtration system and a Reverse Osmosis system.

Effluent Characteristics:

Table 8: Effluent Characteristics

Sl No	Parameter	Raw Effluent	After Anaerobic	Treated Effluent
1	Effluent flow rate	300 m^3/d	300 m^3/d	300 m^3/d
2	pH	4.0 – 9.0	7.0 – 8.5	7.0 – 8.5
3	Temperature	< 40° C	< 35° C	< 35° C
4	Chemical Oxygen demand	4,000 mg/L	< 600 mg/L	< 100 mg/L
5	Biochemical Oxygen demand	2,500 mg/L	< 200 mg/L	< 30 mg/L

6	Oil & Grease	50 mg/L	< 20 mg/L	< 10 mg/L
7	Total Suspended Solids	500 mg/L	< 150 mg/L	< 50 mg/L

The wastewater generated from the unit will have various pollutants which exert high BOD and COD load. From the above table it is observed that incoming dairy effluent has a BOD of 2,500 mg/L and COD of 4000 mg/L which after treatment is reduced to less than 30 mg/L and 100 mg/L respectively.

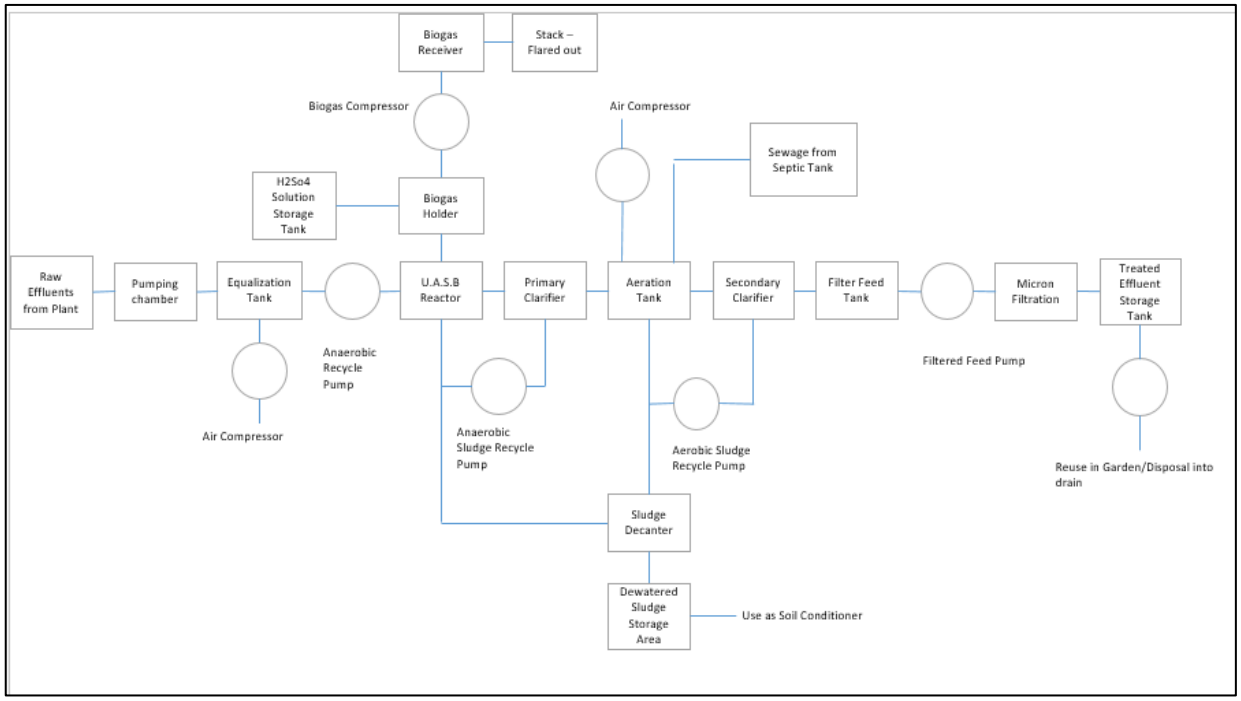

Figure 5: Process flow of ETP

Current Treatment Process:

- 300 m3/d of raw effluent from different trade activities flows to ETP by gravity.
- It first gets collected in equalization tank for homogenization of the quantity and quality. Acid / Alkali solution is added to neutralize the effluent, if required.

Figure 6: Equalization Tank and Screen Chamber

- Homogenized and neutralized effluent from equalization tank is pumped @ 15 m^3/h to UASB reactor bottom and distributed uniformly through the inlet distribution system.

Figure 7: UASB Reactor

- It passes upwards through the dense anaerobic sludge bed. Organic matter is rapidly utilized by biomass and converted to methane rich biogas. Upward circulation of water and biogas purging from the bottom of the reactor keeps the biomass in suspension and break any scum formation.
- The three-phase separator at the top of the UASB reactor allows effective degasification to occur. The dense, granular sludge particles, devoid of attached gas bubbles, sink back to the bottom establishing a return downwards circulation. The treated effluent flows into collection channels at the top of the settlers for discharge and transferred to the clarifier – 1. Washed out anaerobic biomass is recovered and recycled to the reactor. Excess biomass from Anaerobic Process is wasted to sludge dewatering system, if required.
- Biogas is collected in gas collection portion of three phase separator at the top of the reactor and transferred to waste gas burner.
- Aerobically treated effluent is transferred to Aeration Tank. A culture of aerobic bacteria decompose organic impurities in to CO_2. A coarse bubble aeration grid is provided to supply O_2 to aerobic bacterial culture. Air is supplied by the same twin lobe air compressor system.
- Treated effluent flows through the clarifier - 2 to retain bacterial culture. The heavy biomass flocs get settled in the bottom and clear treated effluent flows into outlet channel.

Figure 8: Aeration Tank

- Aerobically treated effluent is collected in a treated effluent collection sump, it is pumped to Duel media pressure filter for polishing.

Reclaimed water will be is suitable for irrigation or feeding to softener for reuse in boiler and cooling tower.

Currently the bio gas generated from the ETP is flared out through stack. Total biogas generated is 400 – 425 m^3/d at design loading of 300 m3/d effluent flow and 4,000 mg/L COD which has a C.F. value equivalent to 5,600 Kcal / m^3.

3.2 Recommendation

From the existing system since the gas production is in the range of 400 -425 m^3/day, it is recommended to install bio gas engine with generator to produce electricity from bio gas rather than flaring it out. Biogas production will be continuous and for 24 hours.

Figure 9: Proposed System

The organic fraction of the solid waste has been recognized as a valuable resource that can be converted into useful products using microbes. Anaerobic digestion is a well-established technology for treatment of organic wastes. Biodegradation of the organic wastes in the absence of oxygen produces biogas, which is a mixture of methane and carbon dioxide as major components and traces of hydrogen, ammonia, hydrogen sulphide, etc. Biogas can be used for thermal applications, such as water heating, drying, boiler fuel, etc., or for electricity generation. The digested material available after the anaerobic treatment may be used as a soil conditioner after composting/ vermicomposting. Dual benefits reaped using anaerobic digestion processes for organic solid waste are simultaneous removal of organic pollutants and waste stabilization as well as production of renewable energy in the form of biogas.

The biogas holder will have about 1 m^3 storage volume. This biogas will be transferred to biogas holder for intermediate storage. Then the gas will be pumped through a compressor and stored in a biogas capsule. It will be then used in the biogas engine. The estimated potential of generation is 90 - 950 units per day which is around 40 kW generation considering generator efficiency of 37 % and gas availability of 85%.

3.3 Supplier Details

Table 9: Supplier Detail

Equipment Detail	Bio Gas Power Generator
Supplier Name – Quotation Attached in Annexure	Environponics Solutions Pvt Ltd
Address	9, New Natraj Park Society, Bopal Ghuma Road, Bopal, Near India Colony, Bopal, Ahmedabad, Gujarat 380058
Contact Person	Mr. Deep Modi
Mail Id	environponics@yahoo.com
Phone No	+91 9825021159
Supplier Name	Sun Envrio Technologies Pvt Ltd

Address	Ashok Colony, Plot No. 22, Near Union Bank, Pratap Nagr, Nagpur - 440 025
Contact Person	Ms. Prachi Doye
Mail Id	sunenviro@sunenv.com
Phone No	+91-712-2282608

3.4 Savings

The expected electricity savings by 40 kW Bio Gas power generator is 2,51,989 kWh annually . The annual monetary saving for this project is ***Rs 16.12 Lakhs with an investment of Rs 31.86 lakhs and payback for the project is 24 months.***

Detailed savings calculations is given in below table

Table 10: Savings Calculation

Parameters	UOM	
COD Inlet	mg/l	4000
COD after anaerobic Digestion and before polishing	mg/l	600
Flow	m^3/day	300
COD Reduction	mg/lit	3400
CH4 Generation Potential	m^3/kg COD	0.4
CH4 Generation per day	m^3/day	408
GCV	kCal/m^3	5600
Energy Generation per day	Kcal/day	2284800
Generator Efficiency	%	35
Power Generation	kW	38.74
Bio Gas Availability	%	85.00
No of operating hours	hrs/day	24
No of days	Days/year	365
Annual Electricity Generation	kWh	2,88,489
Annual Auxiliary Power Consumption @ 100 units per day	kWh	36500
Total Electricity Generation	kWh/year	2,51,989
Electricity Cost	Rs/kWh	6.4
Annual Savings	Rs Lakhs	16.12
Investment	Rs Lakhs	31.86
Pay Back	Months	24

4. FINANCIAL ANALYSIS

4.1 Project Cost

Table 11: Project Cost

Parameter	Amount in Rs Lakhs
Equipment Cost	25.00
Erection, Piping and Commissioning	2.00
GST @18%	4.86
Total Project Cost	**31.86**

4.2 Assumptions for Financial Analysis

- Interest rate taken as 12 %
- Yearly increase in electricity cost by 2% for cash flow analysis
- Life cycle of the project is taken as 7 years
- Three different Capital Structure considered
    - CS1 – 70:30 Debt Equity Ratio
    - CS2 – 50:50 Debt Equity Ratio
    - CS3 – 100 % Equity
- Return on equity is taken as 15 %
- Depreciation – 40%
- Operation and Maintenance Cost taken as 5% of Initial investment
- For calculating weighted average cost of capital, tax rate is assumed as 30 %

4.3 Cash Flow Analysis

Table 12: Cash flow of the project

Cash flow for the project		1	2	3	4	5	6	7
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Required Investment	31.86							
Energy Savings		16.13	16.45	16.78	17.11	17.46	17.81	18.16
O&M Cost		-1.59	-1.59	-1.59	-1.59	-1.59	-1.59	-1.59
Depreciation		12.7	7.6	4.59	2.8	1.7	1.0	0.6
Net Cash Flow	-31.86	27.28	22.50	19.77	18.27	17.52	17.20	17.16

The table below shows the various capital structure assumed for the project finance.

Table 13: Capital Structure

Capital Structure			
Particulars	CS 1	CS 2	CS 3
Debt	70	50	0
Cost of Debt	0.12	0.12	0.12
Equity	30	50	100
Cost of Equity	0.15	0.15	0.15
WACC	10.38	11.7	15

Table 14: NPV Calculation

NPV Calculation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	NPV
NPV at CS 1 (70:30)	**-31.86**	**24.7**	**18.5**	**14.7**	**12.3**	**10.7**	**9.5**	**8.6**	**67.1**
NPV at CS 2 (50:50)	**-31.86**	**24.4**	**18.0**	**14.2**	**11.7**	**10.1**	**8.9**	**7.9**	**63.4**
NPV at CS 3 (100% Equity)	**-31.86**	**23.7**	**17.0**	**13.0**	**10.4**	**8.7**	**7.4**	**6.5**	**54.9**

4.3 Sensitivity Analysis

A sensitivity analysis has been carried out to ascertain how the project financials would behave in different situations such as

- Change in energy savings
- Change in operating hours
- Change in interest rate

A good sensitivity analysis will help to estimate the behavioral nature thereby helping to understand the financial viability over a long period of time.

Table 15: Sensitivity analysis: based on energy savings

Based on Savings	at 100% Savings	at 75% Savings	at 50% Savings
NPV at CS 1 (D70:E30)	67.1	46.7	26.3
NPV at CS2 (D50:E50)	63.4	40.1	21.7
NPV at CS3 (D0:E100)	54.9	37.3	19.7
IRR	71%	56%	39%

Table 16: Sensitivity analysis: change in operating hrs

Based on Operating Hours	at 100% operating hours	at 90% Operating hours	at 80% Operating hours
NPV at CS 1 (D70:E30)	67.1	59.0	50.8
NPV at CS2 (D50:E50)	63.4	55.5	47.7
NPV at CS3 (D0:E100)	54.9	47.9	40.8
IRR	71%	65%	59%

Table 17: Sensitivity analysis: change in interest rate

Based on Interest Rate	at 9.5% interest rate	at 10.05% interest rate	at 11% interest rate	at 12% Interest Rate	at 12.5% Interest Rate	at 13% Interest Rate
NPV (70:30)	70.9	69.3	68.6	67.14	66.42	65.71

5. ENERGY EFFICIENCY FINANCING IN MSMEs

Financing plays a key role in facilitating procurement and implementation of energy efficient technologies and products in any industry. Government has given EE financing in MSMEs top priority since the sector contributes significantly towards India's economic growth. However, existing financing options are not sufficient to meet the financing requirement in the sector due to the large size of the sector. MSMEs using various financing schemes for technological up-gradation are still very less, as most of them use their own capital fund rather than making use of external financing models. Although financing models were very successful in some clusters, the scale-up of such activities is rather slow. This slow pace in implementation of energy efficiency financing in MSMEs is due to the various sector specific challenges in the sector.

Some of the key barriers to finance EE projects in the sector are:-

- Lack of available capital for investment as EE interventions being small may not get financed through FIs as they do not qualify as term loans
- Lack of clarity on financing schemes- repayment mechanism and complex procedural requirements
- Lack of availability of financing model that cater to the particular requirement of the MSME
- Lack of awareness among MSMEs with respect to benefits of implementing EE technologies
- FIs consider MSMEs as a high-risk category due to low credit flow to this sector. This is due to several factors such as poor book-keeping practices, weak balance sheets, poor credit history and smaller sizes of MSME loans.
- Collateral based lending, advocated by FIs, restricts MSMEs from availing loans
- No formal M&V procedure available to estimate the savings achieved by implementing EE measure
- Risks associated with repayment of loans which include technical, commercial and performance risks

5.2 FI Schemes in Gujarat

Table 18: FI schemes in Gujarat

Sl.No	Name of Scheme	Purpose	Financial Details	Contact Address
1	SIDBI Make in India Soft Loan Fund for Micro, Small & Medium Enterprises (SMILE)	• The focus of the scheme is on technology upgradation which helps in reducing the impacts from process and operations as the reduction in resource consumption and productivity improvements are major outcome of technology upgradation • The program aims to bridge the gap by providing financial support to the companies.	• Rate of interest is according to credit rating • Interest rates for soft loans are from (8.90 % to 8.95 % pa) and term loans are in the range of (9.45% to 9.60% pa) • Min loan amount: Rs 25 Lakhs • Term Loan: 75% of the project cost as debt	Ramkrishna Nagar Street Number 12, Ram Krishna Nagar, Rama Krishan Nagar, Rajkot, Gujarat 360001 Ph No : : 0281 246 5083 Mail Id: rajkot@sidbi.co.in
2	4E scheme (End to End Energy Efficiency Financing scheme)	• The 4E scheme promoted by SIDBI aims to assist the industries in implementation of energy efficiency and renewable energy projects. • The scheme addresses all aspects of energy efficiency in a company from assessment and identification of energy efficiency interventions to facilitating implementation by providing technical and financial support	• Interest rate - 2.5% below market interest rate • Min loan amount: Rs 10 Lakhs • Max loan amount: Rs 150 Lakhs • 90% of the project cost as debt	Ramkrishna Nagar Street Number 12, Ram Krishna Nagar, Rama Krishan Nagar, Rajkot, Gujarat 360001 Ph No : : 0281 246 5083 Mail Id: rajkot@sidbi.co.in
3	Partial Risk Sharing Facility for Energy Efficiency project (PRSF)	• The partial risk sharing facility aims at transforming the energy efficiency market in India and promotion of Energy Service Contracting Model for the Energy Efficiency. • The scheme address barrier related to the financing aspects for energy efficiency	• Term Loan: 12%-15% • Min loan amount: Rs 10 Lakhs • Max loan amount: Rs 15 Cr • Total Project funding of – USD 43 million • Risk Sharing facility component of USD 37 million to be managed by SIDBI • Technical assistance component of USD 6 billion to be managed by SIDBI and	Ramkrishna Nagar Street Number 12, Ram Krishna Nagar, Rama Krishan Nagar, Rajkot, Gujarat 360001 Ph No : : 0281 246 5083 Mail Id: rajkot@sidbi.co.in

			EESL	
4	Bank of Baroda's Scheme for Financing Energy Efficiency Projects	All these Schemes from various banks (SBI, Bank of Baroda, Canara Bank) have their focus towards technology upgradation. Technology upgradation can lead to improvement in energy, productivity, and lower emission from the MSME company. As technology upgradation could be capital intensive most of the schemes from banking institutions aim at bridging the gaps for access to finance for MSME sector	• Loans of up to 75% of the total project cost, subject to maximum of Rs. 1 crore, will be provided. (Minimum amount of loan Rs. 5 Lakhs • Collateral will be required for all loans. An interest rate of bank base rate + 4% will be applicable, to be paid back over a period of 5 years.	Bank of Baroda SME Loan Factory 2nd Floor Baroda Towers, Ellisbridge, Ahmedabad Ph No : 9979867501 Mail Id : cpc.sme.ahmedabad@bankofbaroda.com
5	Canara Bank's Loan scheme for Energy Savings ++++++++++++++++++for SMEs		• The scheme covers up to 90% of project costs of up to INR 1 million (EUR 13,000). • Max. loan: INR 10 million (EUR 130,000) • Security: collateral free up to INR 5 million (EUR 65,000), beyond INR 5 million collateral required as determined by the bank • Margin: 10% of project costs	Shop No 1,2,3, Ground Floor, Shyam 80 ft Road, Bhaktinagar Circle, Rajkot Ph No : 0751-2233141/ 2431541 Email Id : cb3888@canarabank.com
6	SBI's Project Uptake for Energy Efficiency		• SBI identifies industrial clusters with potential for quick technology upgradation and a supporting environment. Based on studies in interested units, technology upgradation is undertaken if the same in viable. • With a ceiling of INR 1 lakh, an amount equal to that invested by the unit is provided under this loan. There is a start-up period of 3 years, with a repayment period of 5-7 years, at zero interest.	Opp. Swaminarayan Gurukul Bridge, Gondal Road, Rajkot, Gujarat 360002 Ph No : 0281 236 3927 Email Id : sbi.60438@sbi.co.in
7	Solar Roof Top Financing Scheme IREDA	The loan scheme is applicable to grid interactive, rooftop solar PV plants for industries, institutions and commercial establishments. Financing can be	• Interest rate: 9.9% - 10.75% • Max. repayment time: 9 years • Minimum promoter's contribution: 30% • The applicant's minimum capacity needs to be 1MW	IREDA Camp Office 603, Atlanta Towers Near Panchvati Circle, Gulabi Tekra Ahmedabad

		accessed for single or aggregated investments.		Ph No : 9811889805 Email Id : ashokyadav@ireda.in
8	SBI - World Bank: Grid Connected Rooftop Solar PV Program	Loans for financing grid connected rooftop solar photovoltaic (GS- RSPV)	• Loan amount is 75% of the project cost • Fixed Asset coverage ratio: >1.25 • Moratorium period: upto 12 months from date of commencement of commercial operations • Guarantee: in case of sole proprietorship/partnership firm/personal guarantee of partners	Opp. Swaminarayan Gurukul Bridge, Gondal Road, Rajkot, Gujarat 360002 Ph No : 0281 236 3927 Email Id : sbi.60438.in

6. ENVIRONMENTAL AND SOCIAL BENEFIT

6.1 Environmental Benefit

A resource-efficient business demonstrates a responsibility towards the environment. Energy and the environment are so closely linked, that, in addition to saving energy and reducing utility expenses, there are additional and often unreported benefits from conserving energy, saving natural resources being an important benefit.

Energy efficiency plays a major role, even where company output is increased, energy efficiency improvements can contribute significantly in most cases to reducing the negative impact of energy consumption per unit of output. Any increase in pollutant emissions will thus be minimized. Significant environmental benefits gained by adopting energy efficient technologies and processes may include lowering the demand for natural resources, reducing the emission of air pollutants, improving water quality, reducing the accumulation of solid waste and also reducing climate change impacts. Improving energy conservation at the facility can improve the facility's overall efficiency, which leads to a cleaner environment.

Reduction in Pollution Parameters

The proposed EE measure of installing Bio Gas power generator would result in annual electricity savings of 2,51,989 kWh which is equivalent to 21.67 TOE per annum. The proposed EE measure will result in decrease of CO_2 emissions by 206.63 TCO_2 annually, thus resulting in reduced GHG effect.

6.2 Social Benefit

Work Environment

The Factories Act, 1948 covers various aspects relating to working environment maintenance and improvement. The good maintenance practices, technology up gradation, efficient use of energy and resource conservation not only contribute to energy and pollutant reduction but also contributes in ensuring safe and clean working environment to the employees of the organization. Many units have also been doing review of safety process and have provided access to safe working environment to the workers. Basic facilities such as first aid kit, PPE gears and many others have been made available

Skill Improvement

Implementing energy efficiency measures requires mix of people and skills. It involves up skilling workers at all levels from the shop floor to the board room to understand how companies manage their energy use—and to identify, evaluate and implement opportunities to improve energy performance. As the project involved identifying energy saving projects, implementing and verifying the savings, the unit have understood how to estimate energy savings with respect to energy saving proposals and also energy wastage have been identified. The activity has been

successful in bringing the awareness among workers on energy wastage reduction, technology up gradation possible, etc. Each new technology implemented in a dairy plant will create an impact on the entire Gujarat Dairy cluster as each dairy unit can replicate the new technology and promote the concept of energy efficiency in entire Gujarat Dairy Cluster and thus reduce the overall energy consumption of the cluster as a whole.

Technical skills of persons will be definitely improved. As the training provided by the OEMs on latest technology will create awareness among the employees on new trends happening in market. The training also helps in improving the operational and maintenance skills of manpower required for efficient operation of the equipment.

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7. CONCLUSION

Energy efficiency is an instrument to address the issue of energy crisis and also be employed as a cost effective means to attain sustainability and business. Cost of energy is considered as a vital component for industries and warrant judicious use of energy. Amid spiraling power cost energy efficiency assumes at most importance for the sector to remain competitive.

The GEF, UNIDO and BEE project through its various engagements is able to demonstrate energy efficiency potential in Gujarat Dairy cluster. The project is able to promote the concept of energy efficiency and renewable energy in dairy cluster through various capacity building programs for local service providers, technology feasibility studies in dairy units, training programs on EE/RE technologies and also helped in penetrating new /latest technologies into the cluster.

The DPR for installation of 40 kW Bio Gas power generator has been prepared after the OEM came to the dairy and done a detailed feasibility study. The implementation of this measure will significantly will result in an annual electricity savings of 2,51,989 units with 206.63 TCO_2 reduction. The following table gives the overall summary of the savings achieved:

Table 19: Proposed EE Measure

Sl No	EE Measure	Annual Energy Savings		Monetary Savings (Rs. Lakhs)	Investment (Rs. Lakhs)	Payback (Months)	AnnualTCO_2 reduction
		kWh	TOE				
1	40 kW Bio Gas Power Generator	2,51,989	21.67	16.13	31.86	24	206.63

The summary of financial analysis given in the below table clearly indicates that implementation of this project is economically and financially viable with an attractive payback period. So it is recommended to install bio gas power generation system in the plant.

Table 20: Financial Analysis

Sl. No.	Particulars	Unit	Value
i	Total Investment (Incl of Tax)	Rs. Lakh	**31.86**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**71.44**
Iv	NPV at 70 % Debt	Rs. Lakh	**67.14**

7.1 Replication Potential

Bio methanation and generating power from bio gas has a good replication potential in Gujarat Dairy cluster. The methane generated from conventional aerobic treatment has negative impact and all the dairies which have aerobic treatment have good potential of capturing this methane through various processes. Biogas thus generated have a good calorific value and can be used for thermal applications, such as water heating, drying, boiler fuel, etc., or for electricity generation. The digested material available after the anaerobic treatment may be used as a soil conditioner after composting/ vermicomposting.

The implementation of this project will inspire other units to take up similar energy efficiency initiatives which eventually will lower the bottom line and increase the top line therefore the margin increases. Secondly, the very clear specifications on vendor and the cost base is already available which makes it easy for other units in the Gujarat Dairy cluster to access the technology and gives them a very good idea about the cost and benefits associated with the projects. Overall, the holistic approach adopted by the project will be extremely useful in achieving the goal of improving EE in the cluster.

8. ANNEXURE

8.1 Financial Quotation

Estimate of capital cost for Power generation From Biogas

Sr.	Particular	Estimated Cost
1	Civil work	Rs. 2,00,000/-
2	Biogas holder	Rs. 1,00,000/-
3	Biogas compressor with moisture remover	Rs. 4,00,000/-
4	Biogas receiver	Rs. 2,00,000/-
5	Biogas Purifier (H_2S remover)	Rs. 1,00,000/-
7	Biogas Engine with generator	Rs. 10,00,000/-
8	Hot water generator	Rs. 4,00,000/-
9	Chimney	Rs. 1,00,000/-
10	Internal piping	Rs. 1,00,000/-
11	Electrification and automation	Rs. 1,00,000/-
	Total	**Rs. 27,00,000/-**

Prepared for M/s Sarhad Dariy
Mr. Deep Modi
Environponics Solutions Pvt. Ltd.
Ahmedabad, Gujarat, India