August 2018

DETAILED PROJECT REPORT ON DE SUPERHEATER

M/s Jorethang Dairy Plant – Sikkim Dairy Cluster

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

Bureau of Energy Efficiency
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Prepared by

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List of Abbreviations

BEE	Bureau of Energy Efficiency
CS	Capital Structure
°C	°Celsius
CO_2	Carbon dioxide
DPR	Detailed Project Report
EE	Energy Efficiency
FI	Financial Institution
GEF	Global Environmental Facility
HSD	High Speed Diesel
IRR	Internal Rate of Return
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
TR	Tonnes of Refrigeration
UNIDO	United Nations Industrial Development Organisation
WACC	Weighted Average Cost of Capital
WHR	Waste Heat Recovery

ACKNOWLEDGEMENT

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We also take this opportunity to express our appreciation to the Original Equipment Suppliers and Local Service Providers for their support in giving valuable inputs and ideas for the completion of the Detailed Project Report.

We would also like to mention that the valuable efforts being taken and the enthusiasm displayed towards energy conservation by the Sikkim 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	Jorethang Dairy Plant
Name(s) of the Plant Head	Mr. T B Subba, DGM
Contact person	Mr. T B Subba
Constitution	Cooperative Society
MSME Classification	Medium Scale
Address:	Sikkim Co-operative Milk Producers Union Ltd, Karfertar, Jorethang South Sikkim, 737121
Industry-sector	Dairy

1.2 Proposed EE Measure

After the discussion with the plant team, it has been decided to install waste heat recovery unit to recover the heat from chiller compressor. 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
		HSD Litres	TOE				
1	Installation of De-super heater	3,051	2.77	2.04	5.19	30	8.18

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	**5.19**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**57.64**
Iv	NPV at 70 % Debt	Rs. Lakh	**7.98**

2. INTRODUCTION ABOUT JORETHANG DAIRY PLANT

2.1 Unit Profile

Sikkim is among the lowest milk producing states in India, with a total production of 0.067 Million Tonnes of milk in 2015-16. There are mainly 2 dairies in Sikkim which are located in southern and eastern part of Sikkim. Jorethang Dairy Plant is located in the Karfetar in Jorethang with daily milk processing of 20,000 to 25,000 litres per day.

Table 4: Unit Profile

Particulars	Details
Name of Plant	Jorethang Dairy Plant
Name(s) of the Plant Head	Mr. T B Subba DGM
Contact person	Mr. Ramesh Chettri
Contact Mail Id	chettriramesh91@gmail.com
Contact No	+91 9002525435
Constitution	Cooperative Society
MSME Classification	Medium Scale
No. of years in operation	36
No of operating hrs/day	8
No of operating days/year	365
Address:	Sikkim Co-operative Milk Producers Union Ltd, Karfertar, Jorethang South Sikkim, 737121
Industry-sector	Dairy
Type of Products manufactured	Milk ,Paneer, Dahi, Butter and Chhurpi

2.2 Production Details

The various products manufactured in Jorethang Dairy Plant are liquid milk, butter, dahi, paneer and churpi. The graph below shows the milk processed during last one year:-

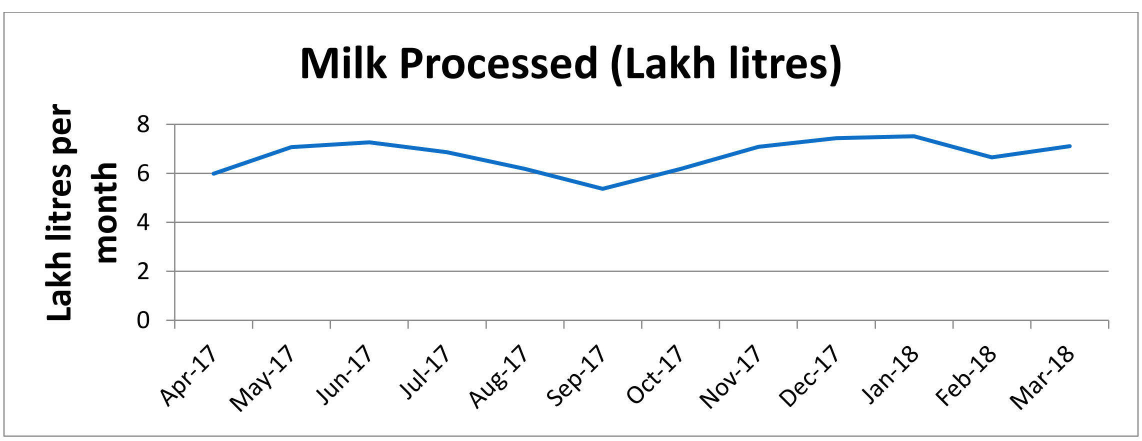

Figure 1: Milk Processed

2.3 Typical Dairy Process Flow Diagram

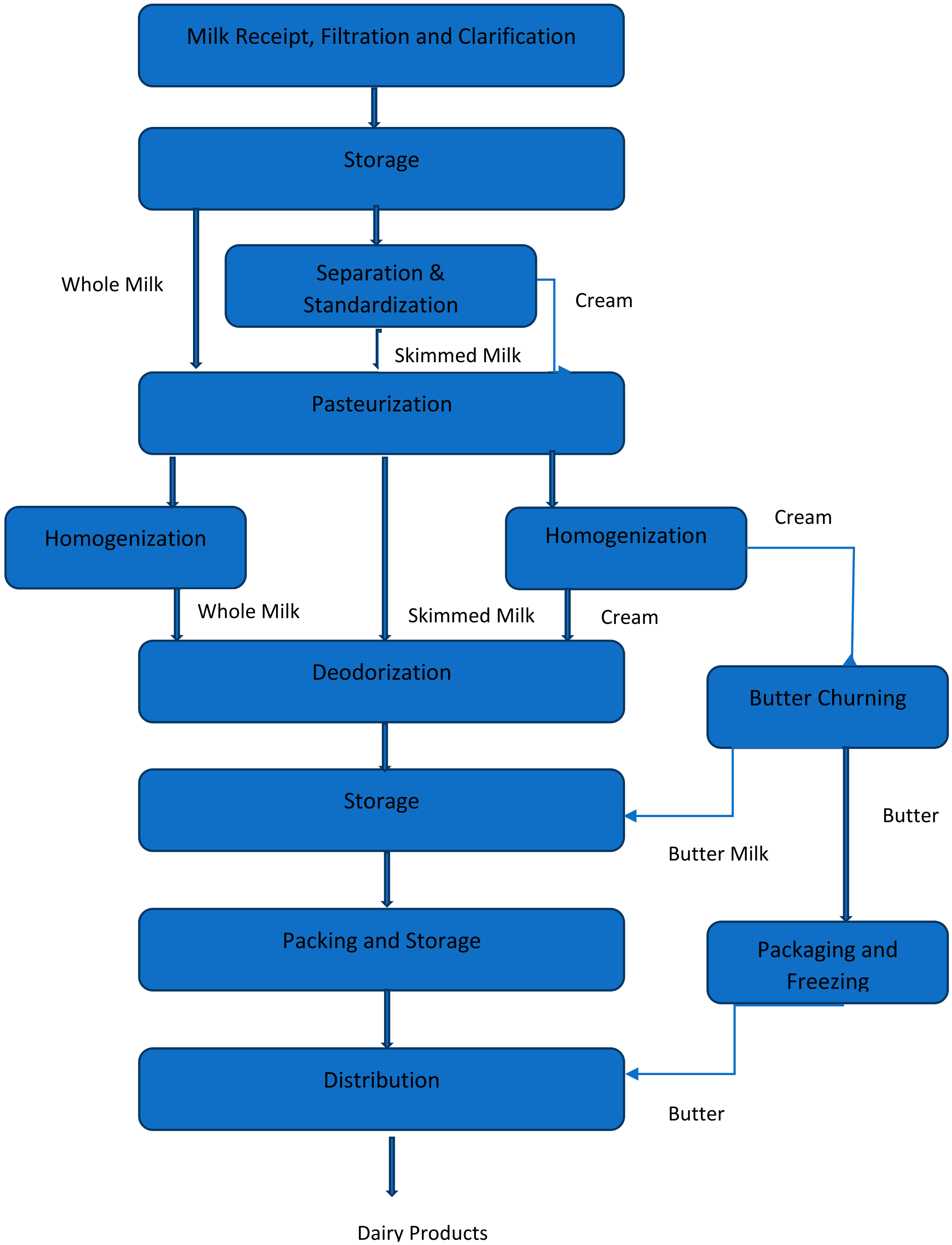

Figure 2: Typical process flow of Milk manufacturing

The processes taking place at 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	0.23
2	Milk Packaging in Poly Pouches	Lakh Litres per Day	0.06
3	Curd Manufacturing	Kg/day	360
4	Butter Manufacturing	Kg/day	80
5	Paneer Manufacturing[1]	Kg/day	160
6	Churpi Manufacturing	Kg/day	13

[1] Based on demand from market

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 (kCal/kg)
1	Electricity	Rs./kWh	4.00	-
2	High Speed Diesel	Rs/L	67	10800

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 (Boiler) – HSD (L)	Fuel Consumption (DG set) – HSD (L)
Apr-17	7,600	3,750	678
May-17	5,600	3,970	1,166
Jun-17	7,760	3,010	734
Jul-17	4,040	3,390	833
Aug-17	7,560	3,120	230
Sep-17	6,000	2,750	1,429
Oct-17	6,920	2,560	300
Nov-17	6,800	3,105	400
Dec-17	3,120	3,620	367
Jan-18	3,120	3,550	16
Feb-18	3,720	3,110	200
Mar-18	3,720	4,325	550
Total	**65,960**	**40,260**	**6,903**

The major form of energy used in the plant is electricity which is from Energy and Power Department Govt. of Sikkim. For thermal energy, plant is using HSD as the main fuel. The percentage share of fuel cost is shown below:-

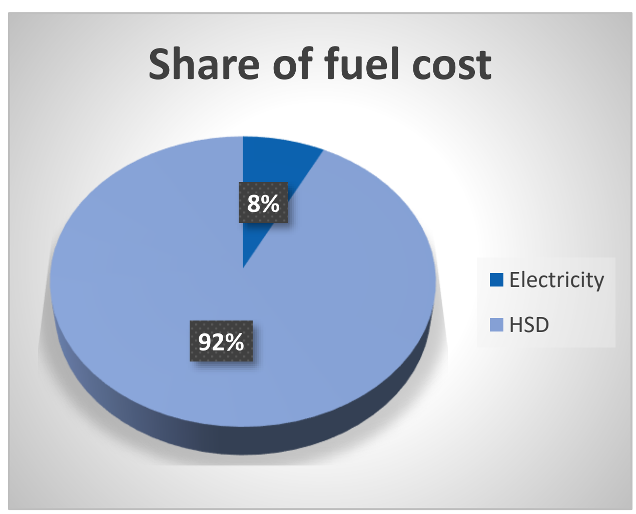

Figure 3: Share of fuel cost

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 0.21 Lakhs/month whereas the average thermal energy cost is Rs 2.6 - 3 lakhs/month.

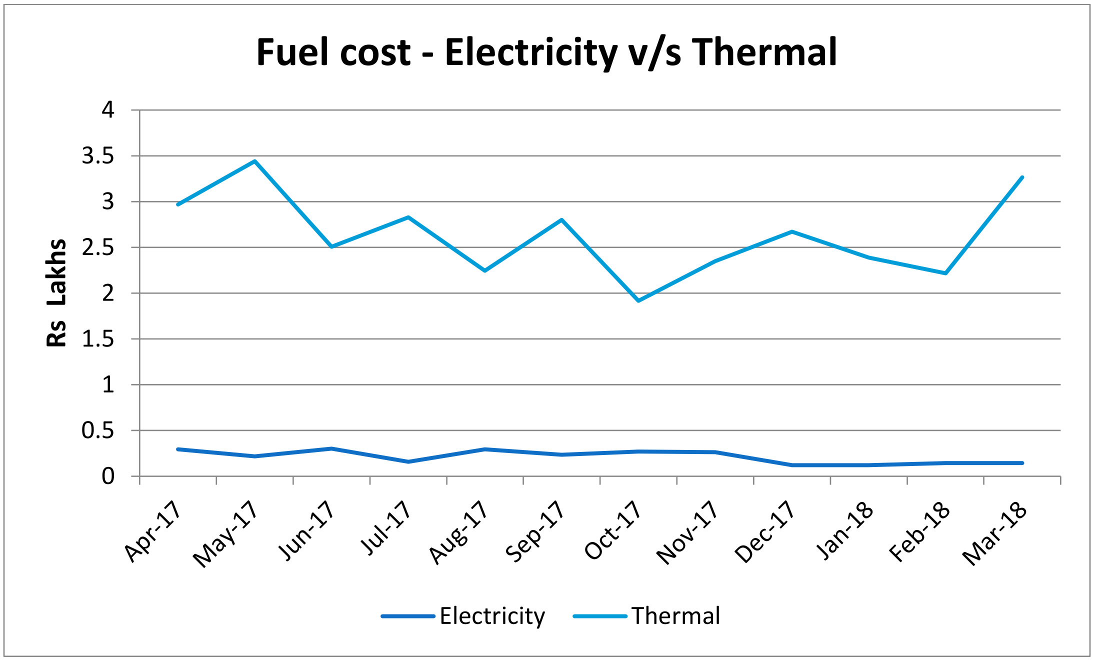

Figure 4: Fuel Cost Electrical vs Thermal

3. PROPOSED EE MEASURE – DE SUPERHEATER

3.1 Present System

Jorethang Dairy Plant has installed reciprocating chiller compressor of 20 TR capacity for the chilled water requirement in the plant. For the refrigeration purpose, vapor compression based ammonia cycle is used.

In a refrigeration cycle, when the compressor is run, the refrigerant starts flowing through the system i.e., the system starts it's working. The compressor continuously sucks low pressure, low temperature refrigerant vapors from the evaporator and pump these to condenser at high pressure and high temperature condition. While flowing through the condenser, the high temperature vapors release their heat to atmosphere and condense to high pressure liquid state. After condenser this high-pressure liquid enters the expansion valve where it is throttled to low pressure. It is so constructed that a control quality of refrigerant flows (due to expansion valve) from one necessary steps to another at definite and predetermined pressure. On throttling the pressure and temperature of refrigerant decreases and when this low pressure, low temperature throttled liquid flows through evaporator, it sucks heat and produce cooling. On absorbing heat in evaporator all the low-pressure liquid evaporates to low-pressure, low-temperature vapors, which are again sucked by compressor. In this way all these processes go on continuously and as long as the compressor runs, the system produces cooling around the evaporator. A block diagram of a vapor compression refrigeration system is shown below[2] :

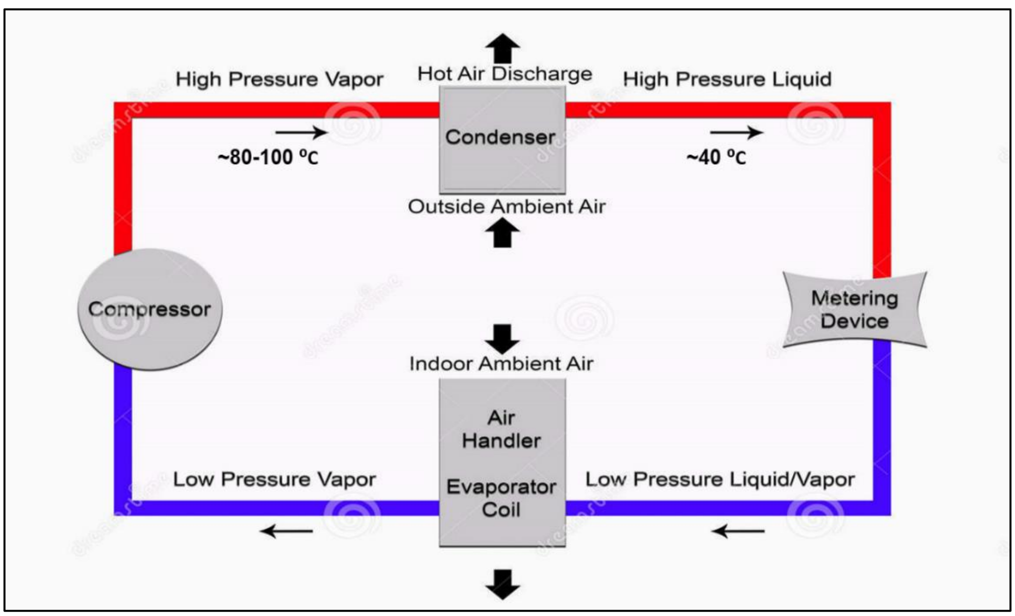

Figure 5: Vapor Compression Cycle

Refrigeration plants with air-cooled and water cooled condensers produce a lot of waste energy by dumping the condensation energy to the ambient air. By installing a desuperheater, a large

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[2] http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1728

proportion of this waste energy can be turned into hot water that may be used for many purposes such as:

- CIP
- Boiler feed water heating
- Process heating for processes like Curd and Ghee preparation
- Crate washing and can washing in chilling centers

3.2 Recommendation

De-super heater is proposed to be installed on chiller compressors to harness waste heat of ammonia gas. Desuperheater is installed on discharge side of NH_3 compressor. The temperature of NH_3 gas observed to be 105°C. This ammonia gas is expected to be cooled to 60 °C and the recovered heat will be used to heat water from 30 °C to 60°C. This hot water is proposed to be used in the boiler feed water. The design of the desuperheater has to ensure that you recover adequate heat with the required temperature lift. Apart from the direct energy saving after getting hot water, the heat load on condenser is expected to come down, and if the design is done appropriately, the condensing pressures can also marginally reduce, leading to reduction in power consumption of compressors.

Desuperheater units are located between the compressor and condenser to utilize the high-temperature energy of the superheated refrigerant gas. By using a separate heat exchanger to utilize the high temperature of the discharge gas, it is possible to heat water to a higher temperature than would be possible in a condenser.

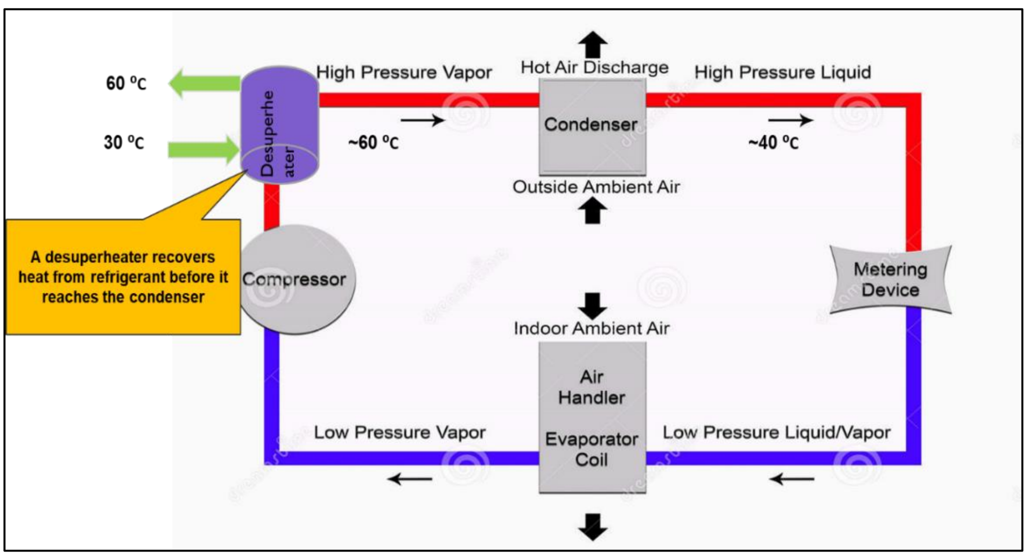

Figure 6: Refrigeration system with desuperheater

Key technical parameters for the heat recovery system are given below:

Table 8: Technical Parameters

Item	Value
Temperature of ammonia gas in/out	110 degC/60 degC
Temperature of water in/out	30 degC/70 degC
Amount of Hot Water Available	256 litre/hour
Heat load recovered[3]	11.92 kW

3.3 Supplier Details

Table 9: Supplier Detail

Equipment Detail	De Super heater
Supplier Name	Promethean Energy Pvt Ltd[4]
Address	Akshar Blue Chip IT Park, Turbhe MIDC, Turbhe, Navi Mumbai : 400706
Contact Person	Mr. Ashwin KP
Mail Id	ashwinkp@prometheanenergy.com
Phone No	+91 9167516848

3.4 Savings

The expected savings by installation of de super heater is 3,051litres of HSD annually. The annual monetary saving for this project is ***Rs 2.04 Lakhs with an investment of Rs 5.19 lakhs and payback for the project is 30 months.***

Detailed savings calculations is given in below table

Table 10: Savings Calculation

Parameters	UOM	
Size of compressor	kW	29.8
Heat Recovery possible	kW	11.92
Heat Recovery possible	kCal/hr	10251
Amount of hot water available for process (from 30 to 70°C)	litre per hour of water at 70°C	256
Hours of operation	hours per day	6
Days of operation	days per year	360
Total heat recovery possible	kCal/year	22142592
Cost of diesel	INR/liter	67
Calorific value	kCal/kg	10800
Boiler efficiency[5]	%	80%

[3] For 15kW of refrigeration load 6 kW heat recovery possible
[4] Only one supplier is available whose supplying WHR from chiller compressor
[5] Measured Boiler Efficiency

Fuel Savings	kg/year	2563
Density of HSD	kg/litre	0.84
Annual Fuel Savings	Litres/year	3051
Cost of HSD	Rs/Litre	67
Annual Cost Savings	Rs Lakhs	2.04
Investment	Rs Lakhs	5.19
Pay Back	Months	30

4. FINANCIAL ANALYSIS

4.1 Project Cost

Table 11: Project Cost

Parameter	Amount in Rs Lakhs
De Super Heater Equipment Cost	2.60
Storage Tank 2000 L	0.30
Installation Cost	1.50[6]
GST Charges @ 18%	1.08
Total Project Cost	**5.19**

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	5.19							
Energy Savings		2.04	2.09	2.13	2.17	2.21	2.26	2.30
O&M Cost		-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26
Depreciation		2.1	1.2	0.75	0.4	0.3	0.2	0.1
Net Cash Flow	-5.19	3.86	3.07	2.61	2.36	2.22	2.16	2.14

[6] Installation Cost is taken as 1.50 Lakhs after discussion with supplier

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)	-5.19	3.5	2.5	1.9	1.6	1.4	1.2	1.1	8.0
NPV at CS 2 (50:50)	-5.19	3.5	2.5	1.9	1.5	1.3	1.1	1.0	7.5
NPV at CS 3 (100% Equity)	-5.19	3.4	2.3	1.7	1.3	1.1	0.9	0.8	6.4

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)	8.0	5.4	2.8
NPV at CS2 (D50:E50)	7.5	4.5	2.2
NPV at CS3 (D0:E100)	6.4	4.2	1.9
IRR	58%	45%	30%

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)	8.0	6.9	5.9
NPV at CS2 (D50:E50)	7.5	6.5	5.5
NPV at CS3 (D0:E100)	6.4	5.5	4.6
IRR	58%	53%	47%

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)	8.5	8.3	8.2	7.98	7.89	7.80

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

5.1 FI Schemes in Sikkim

Table 18: FI schemes in Sikkim

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	Small Industries Development Bank of India (SIDBI) Branch Manager, Deorali School Road, Gangtok
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	Small Industries Development Bank of India (SIDBI) Branch Manager, Deorali School Road, Gangtok
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	Small Industries Development Bank of India (SIDBI) Branch Manager, Deorali School Road, Gangtok

			EESL	
4	Bank of Baroda's Scheme for Financing Energy Efficiency Projects	All these Schemes from various banks (SBI, Bank of Baroda, and 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 MG Marg Gangtok, Sikkim Ph No : 03592 203216 Mail Id : gangto@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	Punam Chand Building, M G Marg Gangtok, Sikkim Email Id : cb2337@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.	SBI National Highway 31 A Gangtok, Sikkim Ph No : (3592) 206091 Email Id : sbi.00232@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	Sikkim Renewable Energy Development Agency, Government of Sikkim D.P.H. Road (Near Janta Bhawan) , Gangtok

		accessed for single or aggregated investments.		Ph No : 03592- 22659 Email Id : slg sreda@sancharnet.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	SBI National Highway 31 A Gangtok, Sikkim Ph No : (3592) 206091 Email Id : sbi.00232@sbi.co.in sbi.co.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 de super heater would result in annual fuel savings of 3,051 litres of HSD which is equivalent to 2.77 TOE per annum. The proposed EE measure will result in decrease of CO_2 emissions by 8.18 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 Sikkim Dairy cluster as each dairy units can replicate the new technology and promote the concept of energy efficiency in entire Sikkim 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.

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 Sikkim 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 de super heater has been prepared after the discussion with the OEM who installed boiler in the plant. The implementation of this measure significantly will result in an annual fuel savings of 3,051 litres of HSD with 8.18 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)	Annual TCO_2 reduction
		HSD Litres	TOE				
1	Installation of De Super heater	3,051	2.77	2.04	5.19	30	8.18

The summary of financial analysis given in the below table clearly indicates that implementation of this project is economically and financially viable with a good payback period. So it is recommended to install de super heater to recover the heat from compressor discharge.

Table 20: Financial Analysis

Sl. No.	Particulars	Unit	Value
i	Total Investment (Incl of Tax)	Rs. Lakh	**5.19**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**57.64**
Iv	NPV at 70 % Debt	Rs. Lakh	**7.98**

7.1 Replication Potential

De super heater has a good potential in Sikkim Dairy Cluster. The system can be easily replicated in the Gangtok dairy plant. Also in the implementation of this project will inspire other units in Sikkim mainly pharma 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 Sikkim 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

Promethean Energy Pvt. Ltd. **Date :26 July 2018**
Technology Solutions
Akshar Blue Chip IT Park, Turbhe MIDC, Turbhe, Navi Mumbai : 400706

Proposal for installation of Heat Recovery equipment on Compressors

To,
Purchase Department,
Jorethang Dairy,
Jorethang, Sikkim

Subject : Installation of ChillerMate Heat Recovery systems from Recip Compressors at Jorethang Dairy Chilling Center.

Dear Ma'am/Sir,

Please find here the proposal for heat recovery based on our site visit and interaction with you. I am including the details of heat recovery potential possible for Accel SMC/6 100 E compressors available at your site, to use the recovered heat for offsetting boiler feed for can washing and feedwater preheating. I have taken care to be conservative in estimates wherever possible. There is expected to be substantial savings in FO/wood consumption, as well as electricity consumption, while at the same time reducing the carbon footprint of the plant and the brand in general.

Sr no.	Item	Amount (INR)
1.	Supply of heat recovery system for **Jorethang Milk chilling centre** **- HSN Code 84041000** Water temperature in/out 30/70 Primary temperature in/out 110/60 Double wall vented systems For installation on Ammonia Compressors Including data monitoring and support accessories	2,90,000
2.	GST@18%	52,200
	Total	3,42,200
	Erection and piping cost (To be done by client)	2,50,000 (expected)

Gala No.28, Gami Industrial Park, Ground Floor, S Central Road, TTC Indl. Area, MIDC Pawne, Navi Mumbai-400705
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