August 2018

DETAILED PROJECT REPORT ON HEAT PUMP

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

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 electrical heat pump for boiler feed water heating. 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 (litre)	TOE				
1	Heat Pump for boiler feed water heating	4,762	4.32	2.55	3.54	17	12.76

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	**3.54**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**105.69**
Iv	NPV at 70 % Debt	Rs. Lakh	**12.85**

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:-

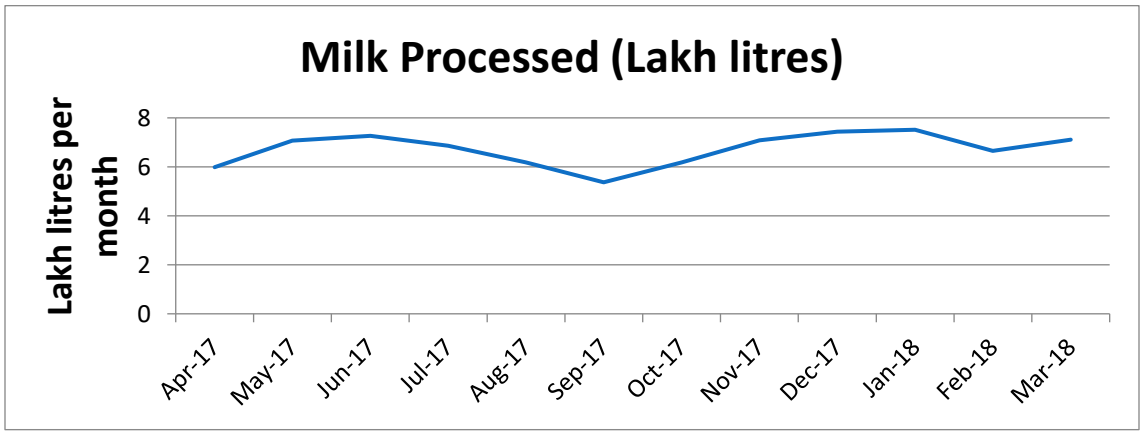

Figure 1: Milk Processed

2.3 Typical Dairy Process Flow Diagram

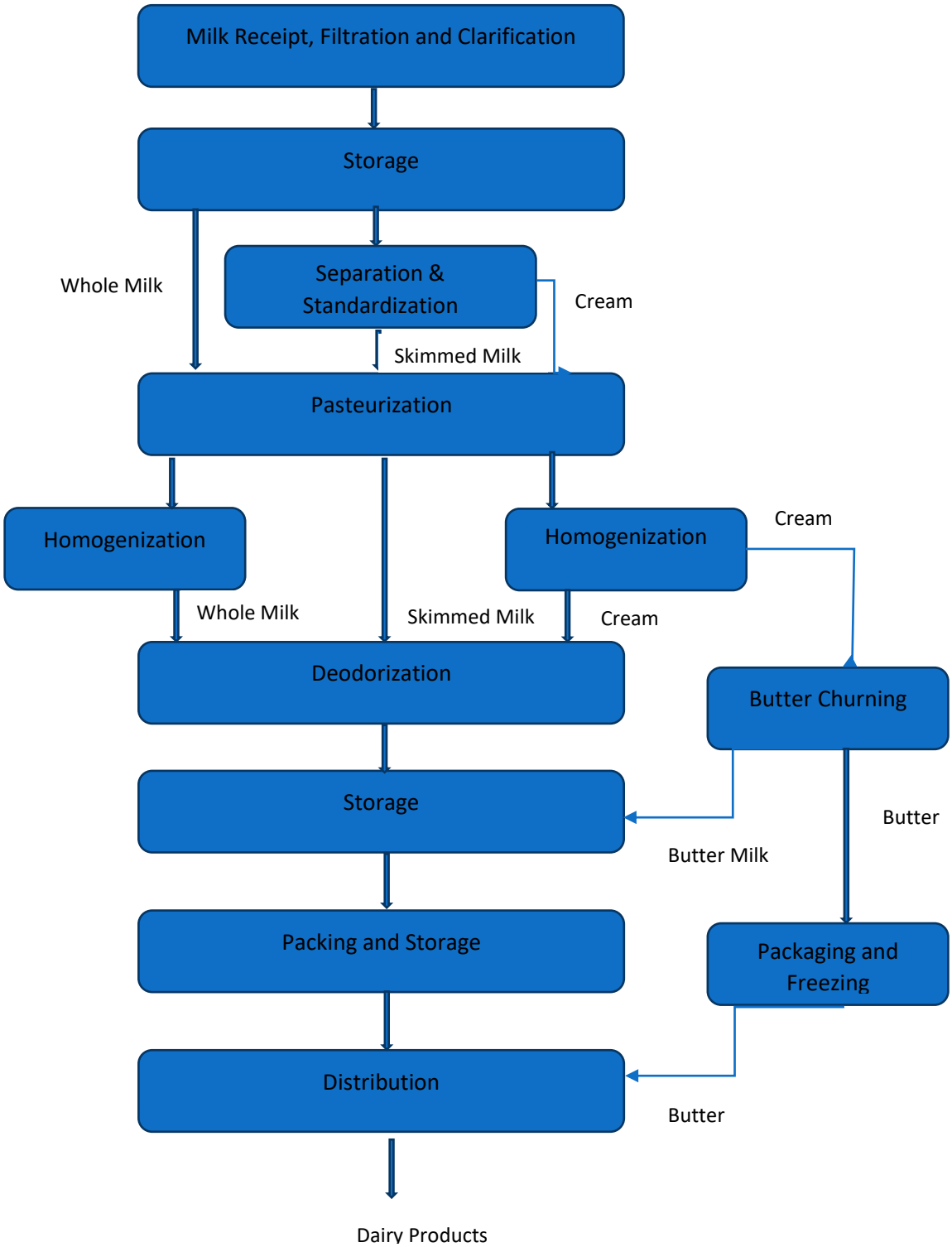

Figure 2: Typical process flow of Milk manufacturing

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:-

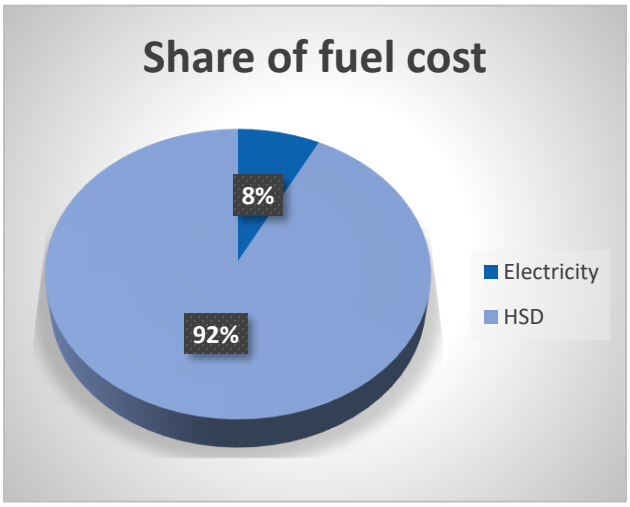

Figure 3: Share of fuel cost

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.

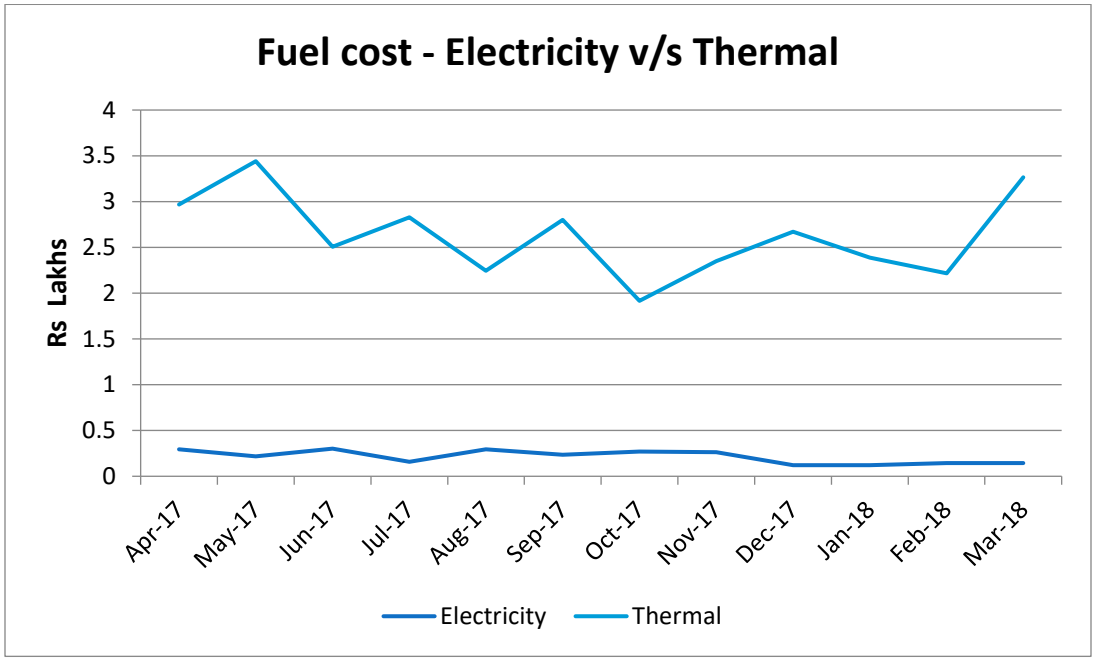

Figure 4: Fuel Cost Electrical vs Thermal

3. PROPOSED EE MEASURE – ELECTRICAL HEAT PUMP

3.1 Present System

Jorethang Dairy Plant has installed one HSD boiler for producing steam at 6 kg/cm^2 which is used in the process application like pasteurization, curd making, CIP, crate washing etc. One boiler is running and one is standby. All the heating process in dairy is through indirect heating.

The table below shows the details of boiler installed in the plant.

Table 8: Boiler Details

Boiler	Fuel Type	Design Capacity (TPH)	Make of the company	Operating Pressure (bar)	Operating Condition	Operating hrs
Boiler 1	HSD Fired	0.6	Energy Solutions	6	Running	6

Table 9: Boiler Efficiency Calculation

Boiler Efficiency Calculation		
Feed Water Temperature	30	°C
Calorific value of fuel	10800	kCal/kg
Density of HSD	0.84	kg/l
Feed Water Flow	320	lph
Feed Water Flow	320	kg/hr
HSD Flow	165	LPD
HSD Flow	27.5	LPH
HSD Flow	23.1	kg/hr
Enthalpy of steam at 6.5 kg/cm2	660	kCal/kg
Feed Water Enthalpy at 30 deg C	30	kCal/kg
Boiler Efficiency	80.0	%

Currently the feed water for the boiler is taken from a 1000 litre tank using a 0.75 kW feed water pump. During the study it was observed that the feed water temperature is 30°C and feed water required for the boiler is 320 litres per hour. Since the boiler feed water is going at ambient condition to the boiler more fuel is to be burned inside the boiler to generate steam at higher temperature. Also lower temperature of feed water can result in the formation of dissolved oxygen which can lead to corrosion.

Figure 5: 600 kG Boiler

3.2 Recommendation

It is recommended to install a 28 kW electrical heat pump for boiler feed water heating from 30°C to 80°C. An EHP system works on the principle of the 'heat pump'. This is the cyclic process in which heat is taken up from an area of cold temperature and discarded into an a rea

of high temperature. A heat pump cannot operate by itself; it requires an external energy source. In an electric heat pump (EHP) system, electrical energy is used to drive the heat pump.

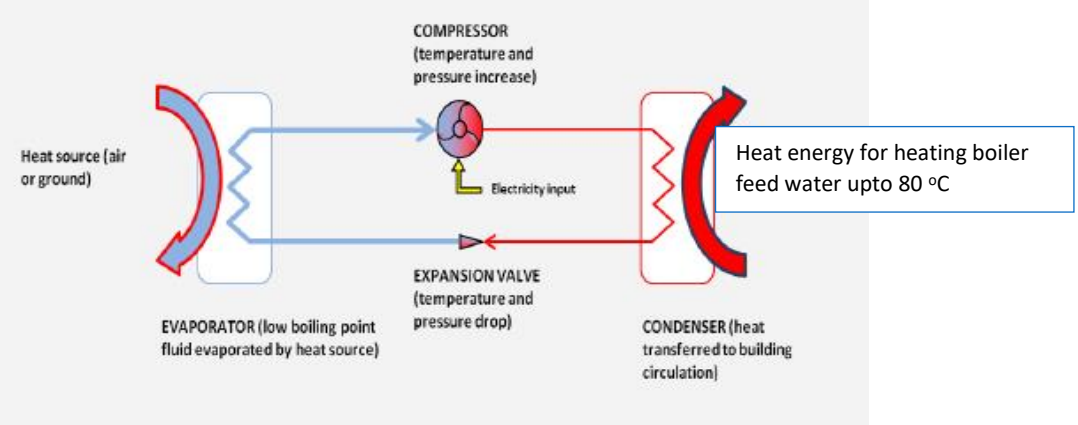

Figure 6 : Heat Pump working

The heat pump is similar to a chiller unit where the utilization point is from condenser part for heating application. It has four basic components compressor, condenser, expansion valve and an evaporator. When electrical energy is given to unit, compressor compresses the R134a refrigerant to high temperature high pressure vapor. From compressor the vapor goes to the condenser which is basically a heat exchanger where on one side boiler feed water is circulated and other side refrigerant flows. The heat from the refrigerant is dissipated to the boiler feed water which in coming at 30°C. The heat is used to heat the boiler feed water to 80°C[2] and fed to the boiler. The refrigerant is then expanded using an expansion valve to low temperature low pressure vapor and given to the evaporator. In the evaporator using small fans installed on the top of heat pump the ambient air is used to evaporate the refrigerant due to it low boiling point. The low temperature low pressure vapor is sucked in by the compressor and cycle is repeated. The COP of heat pump is 2.5 i.e. if 1 kW of energy can generate 2.5 kW of heat energy.

The heat pump is supplied on a rental model for initial period of one year at an amount of Rs 25,000 + 18% GST per month. The rental model will be automatically renewed every year.

3.3 Supplier Details

Table 10: Supplier Detail

Equipment Detail	Electrical Heat Pump
Supplier Name	Aspiration Energy[3]
Address	Aspiration Energy Pvt ltd Mandaveli, Chennai -600028
Contact Person	Mr. Sudharshan R
Mail Id	sudharsan.r@aspirationenergy.com
Phone No	+91 98406 19252

[2] Guaranteed by the supplier
[3] Unique service model on rental basis which is given by only one supplier

3.4 Savings

The expected savings by installation of electrical heat pump is 4,762 litres of HSD annually. The annual monetary saving for this project is ***Rs 2.55 Lakhs with an investment of Rs 3.54 lakhs and payback for the project is 17 months.***

Detailed savings calculations is given in below table

Table 11: Savings Calculation

Parameters	UOM	
Feed Water Temperature	°C	30
GCV of fuel	kCal/kg	10800
Boiler Efficiency	%	80[4]
Feed Water Requirement	kg/hr	320
Feed Water Requirement for 6 hour boiler operation	kg/day	1920
Max temperature delivered by heat pump	°C	80
Heat Energy required to raise temp to 80 °C	kCal/day	96000
Pipe line losses	%	10
Heat Energy required to raise temp to 80 °C after losses	kWh/day	124.03
Operating hrs of heat pump	hrs/day	8
Electrical heat energy of pump	kW	15.50
COP of Heat Pump		2.5
Fuel required for equivalent energy of 96000 kCal/day	litre/day	13.23
Auxiliary Power Consumption of Heat Pump	kW	6
Energy Consumption of heat pump	kWh/day	44.7
Operating days	days	360
Fuel Cost	Rs/litre	67
Electricity Cost	Rs/kWh	4
Annual Fuel Savings	Rs Lakhs	3.19
Electricity cost for running heat pump	Rs Lakhs	0.64
Net Annual Savings	Rs Lakhs	2.55
Size of Heat Pump available for producing 17.44 kW Electrical Heat Energy	kW	28
Investment for 28 kW Heat Pump	Rs Lakhs	3.54
Pay Back	Months	17

4. FINANCIAL ANALYSIS

4.1 Project Cost

Table 12: Project Cost

Parameter	Amount in Rs Lakhs
Heat Pump Cost on rental model per month	0.25
Total cost for a year	3.00
GST Charges @ 18%	0.54
Total Project Cost	**3.54**

The heat pump is supplied on a rental model for initial period of one year at an amount of Rs 25,000 + 18% GST per month. The rental model will be automatically renewed every year.

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 13: 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	3.54							
Energy Savings		2.55	2.60	2.65	2.70	2.76	2.81	2.87
O&M Cost		-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18
Depreciation		1.4	0.8	0.51	0.3	0.2	0.1	0.1
Net Cash Flow	-3.54	3.79	3.27	2.98	2.83	2.76	2.75	2.76

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

Table 14: 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 15: 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)	-3.54	3.4	2.7	2.2	1.9	1.7	1.5	1.4	11.3
NPV at CS 2 (50:50)	-3.54	3.4	2.6	2.1	1.8	1.6	1.4	1.3	10.7
NPV at CS 3 (100% Equity)	-3.54	3.3	2.5	2.0	1.6	1.4	1.2	1.0	9.4

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 16: Sensitivity analysis: based on energy savings

Based on Savings	at 100% Savings	at 75% Savings	at 50% Savings
NPV at CS 1 (D70:E30)	11.3	8.1	4.8
NPV at CS2 (D50:E50)	10.7	7.1	4.1
NPV at CS3 (D0:E100)	9.4	6.6	3.8
IRR	96%	75%	53%

Table 17: 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)	11.3	10.0	8.7
NPV at CS2 (D50:E50)	10.7	9.5	8.2
NPV at CS3 (D0:E100)	9.4	8.3	7.2
IRR	96%	88%	80%

Table 18: 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)	11.9	11.6	11.5	11.29	11.18	11.07

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 19: 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 heat pump would result in annual fuel savings of 4,762 litres of HSD which is equivalent to 4.32 TOE per annum. The proposed EE measure will result in decrease of CO_2 emissions by 12.76 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 heat pump 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 4,762 litres of HSD with 12.76 TCO_2 reduction. The following table gives the overall summary of the savings achieved:

Table 20: Proposed EE Measure

Sl No	EE Measure	Annual Energy Savings		Monetary Savings (Rs. Lakhs)	Investment (Rs. Lakhs)	Payback (Months)	AnnualTCO_2 reduction
		HSD (Litres)	TOE				
1	Installation of Electrical heat pump for feed water heating	4,762	4.32	2.55	3.54	17	12.76

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 electrical heat pump.

Table 21: Financial Analysis

Sl. No.	Particulars	Unit	Value
i	Total Investment (Incl of Tax)	Rs. Lakh	**3.54**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**96.01**
Iv	NPV at 70 % Debt	Rs. Lakh	**11.29**

7.1 Replication Potential

Electrical heat pump for feed water heating 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

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Rental Offer for

Heat Pump System

Submitted to

JORETHANG DAIRY PLANT

SIKKIM

Heat Pump Proposal 2018

ANNEXURE – 2: Rental Offer for Heat pumps

Machine Name	Heat Pump Capacity	Monthly Rental Payment to AEPL
For Boiler feed application	28 kW	25,000
Integration of Heat pump to Existing system	Customer Scope	
Provisioning of Hot water storage tank	Customer Scope	
Transportation to Customer site	Customer Scope / Extra at actuals	

Note:

- **Taxes extra as applicable**

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ANNEXURE – 4: Terms and Conditions

TECHNICAL

1. Savings will be significantly higher if it's operational for more than 80% of the time in a day and vice versa
2. Heat Pump will deliver output of 28 kW per hour and can be loaded up to 25 kW (90%) per hour. If the load is less or more than 90%, then the heat pump may not perform as designed which may result in lesser savings.
3. To get optimum savings from heat pump please make sure, the actual heat load is around 20 – 25 kW per hour and runs between 80% - 100% of the time in a day.
4. Regular preventive maintenance like strainer cleaning, checking of electrical and other items for intact etc., to be done on daily basis by your maintenance team to make sure Heat Pump works optimally as designed.
5. Required electrical cabling including necessary electrical panel to be terminated to heat pump and circulation pumps by the customer.
6. AEPL will take care of quarterly preventive/breakdown maintenance as necessary.
7. Exclusions/Facilities to be provided by customer
    - All masonry work including provision for making and dressing of wall / slab openings for running pipes, cables, masonry trenches and risers including their covering wherever required and foundation for our equipments.
    - Any kind of painting work to match the interior decoration except painting of our equipment as per our standard.
    - Any kind of carpentry, false ceiling, wooden frames etc.
    - Scaffolding for piping / equipment installation, and Scissor lift etc. if available at your facility to be provided to us free of cost
    - Electrical power & water for construction, testing and commissioning at free of cost.
    - Permanent lockable space for locking-up our equipment and tools under security
    - Boarding and Lodging expenses for our engineers, supervisors and labourers

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COMMERCIAL

1. The duration of the rental agreement will be for initial period of 1 year, and automatically renewable every year unless either party gives a three months' notice.
2. The ownership of the equipment will be with AEPL. However, at any point of the contract, the customer can opt to purchase the equipment at the market value.
3. The fixed monthly rental rates will be payable in advance before the 5th of every month.
4. The customer will pay AEPL a refundable security deposit equivalent to 6 months rental payment at the end of trial period. Bank Guarantee equivalent to the amount can also be given to AEPL.
5. All payments towards statutory and other compliance issues will be borne by the customer.
6. AEPL can recall the equipment, after giving sufficient notice to the customer.
7. Rental charges include comprehensive maintenance and insurance costs of the equipment by AEPL. However, Customer will undertake to take day-to-day operations and some preventive maintenance activities.
8. First month rental to be paid in advance along with the work order

TAXES

- SAC code of Heat pump rental is **9973**
- GST @ 18% on rental charges
- Variations if any declared by the Govt. further till billing, will be to your account

ORDER PLACEMENT

GST Number: **33AAICA3250D1Z9**

The order has to be placed on the below address:

M/s Aspiration Energy Pvt. Ltd.,
Registered office: No.7, 2nd Trust Link Road, Mandaveli, Chennai - 600028.

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