August 2018

DETAILED PROJECT REPORT ON 20kWp SOLAR ROOFTOP

M/s Jorethang Dairy Plant – Sikkim Dairy Cluster

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

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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
Dhd	Daily sum of diffuse irradiation [kWh/m2]
EE	Energy Efficiency
Esm	Monthly sum of specific electricity prod. [kWh/kWp]
Esd	Daily sum of specific electricity prod. [kWh/kWp]
Etm	Monthly sum of total electricity prod. [MWh]
Eshare	Percentile share of monthly electricity prod. [%]
FI	Financial Institution
GEF	Global Environmental Facility
Ghm	Monthly sum of global irradiation [kWh/m2]
Ghd	Daily sum of global irradiation [kWh/m2]
HSD	High Speed Diesel
IRR	Internal Rate of Return
kW	Kilo Watt
kWp	Kilo Watt Peak
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
T24	Daily (diurnal) air temperature [°C]
TOE	Tonnes of Oil Equivalent
UNIDO	United Nations Industrial Development Organisation
WACC	Weighted Average Cost of Capital

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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 20 kWp solar roof top as a part of green initiative in the 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	Solar Rooftop 20 kWp	30,660	2.64	1.23	11.55	113	25.14

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	**11.55**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**13.85**
Iv	NPV at 70 % Debt	Rs. Lakh	**0.93**

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:-

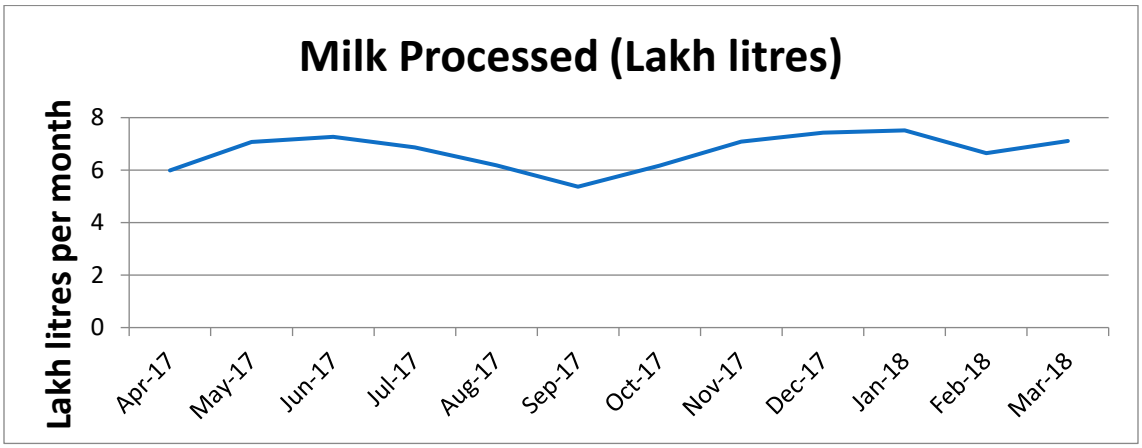

Figure 1: Milk Processed

2.3 Typical Dairy Process Flow Diagram

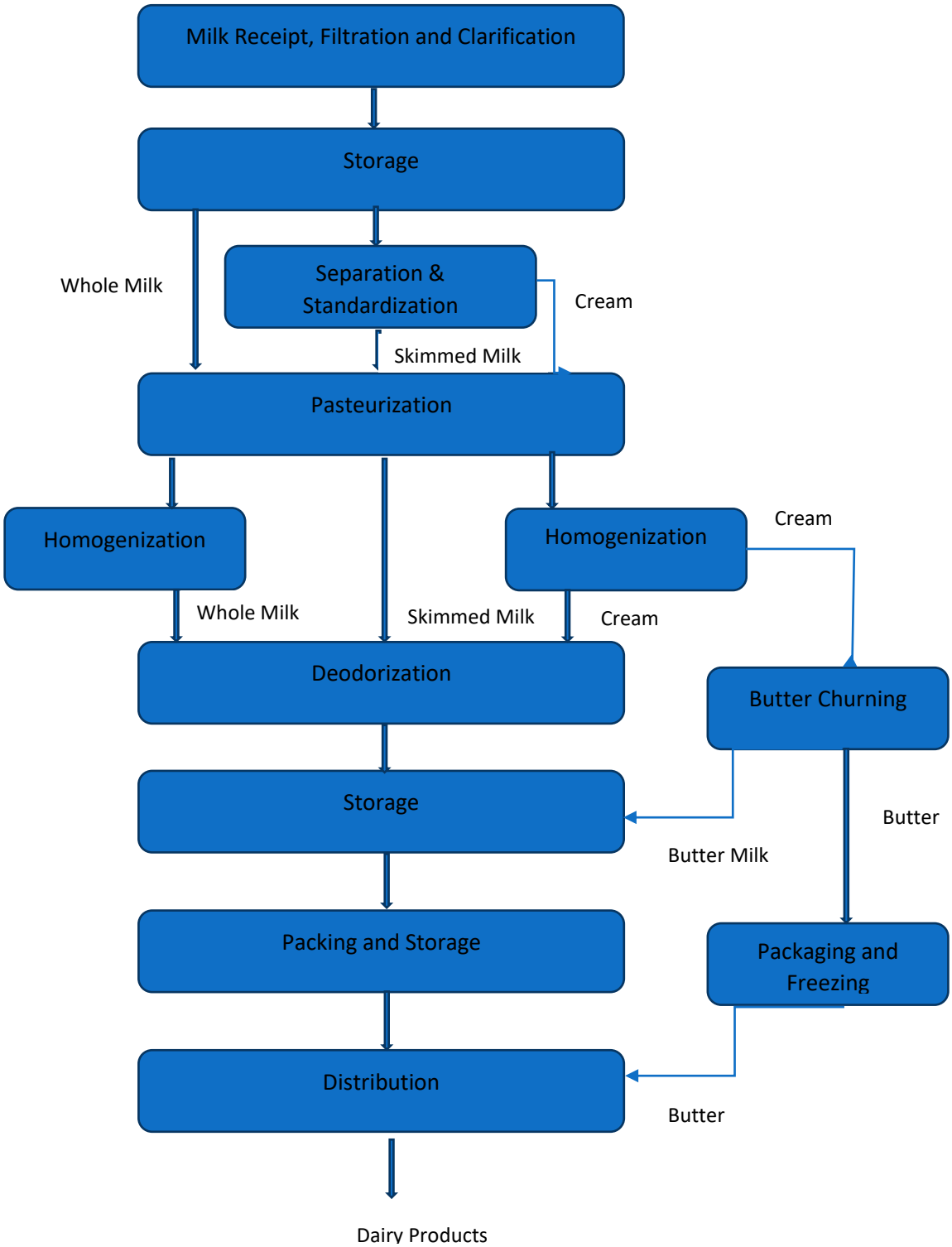

Figure 2: Typical process flow of Milk manufacturing

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:-

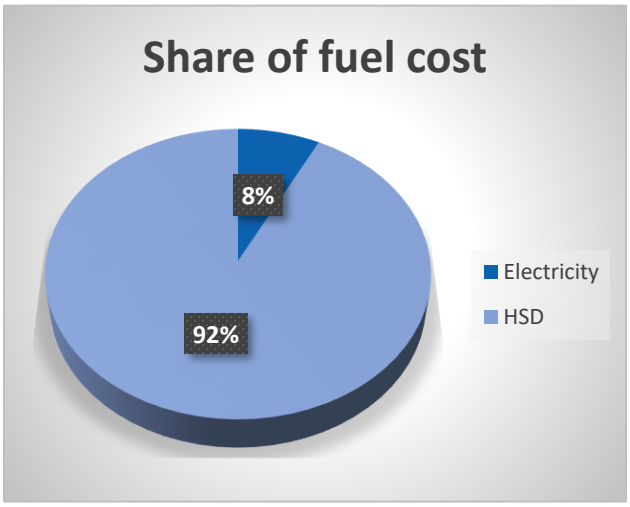

Figure 3: Share of fuel cost

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 – 3.00 lakhs/month.

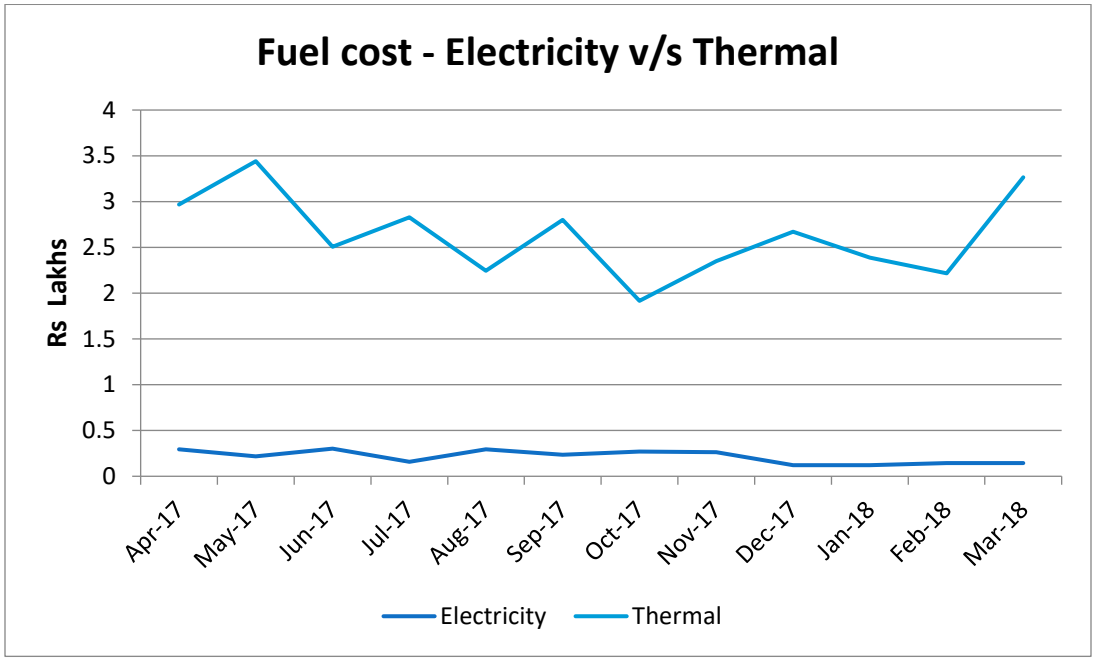

Figure 4: Fuel Cost Electrical vs Thermal

3. PROPOSED EE MEASURE – 20 kWp Solar Roof Top

3.1 Present System

Jorethang Dairy Plant is purchasing electricity from grid for the operation of various equipments in the plant. The contract demand of the plant is 130 kVA with electricity price of Rs 4/kWh with an average load of 40kW.

Observation

During the course of study it was observed that plant has enough roof top area which can be utilized to install solar PV panel to harness solar energy and generate electricity.

Figure 5: Rooftop area for solar

Table 8: Site Specifications

Parameters	
Effective Rooftop available ,sq ft	2000
Location	Latitude: - 27.1317°N, Longitude: - 88.2796°E
Altitude above sea level, m	322
Annual in plane irradiation	1533 kWh/m2

Terrain Horizon and day length

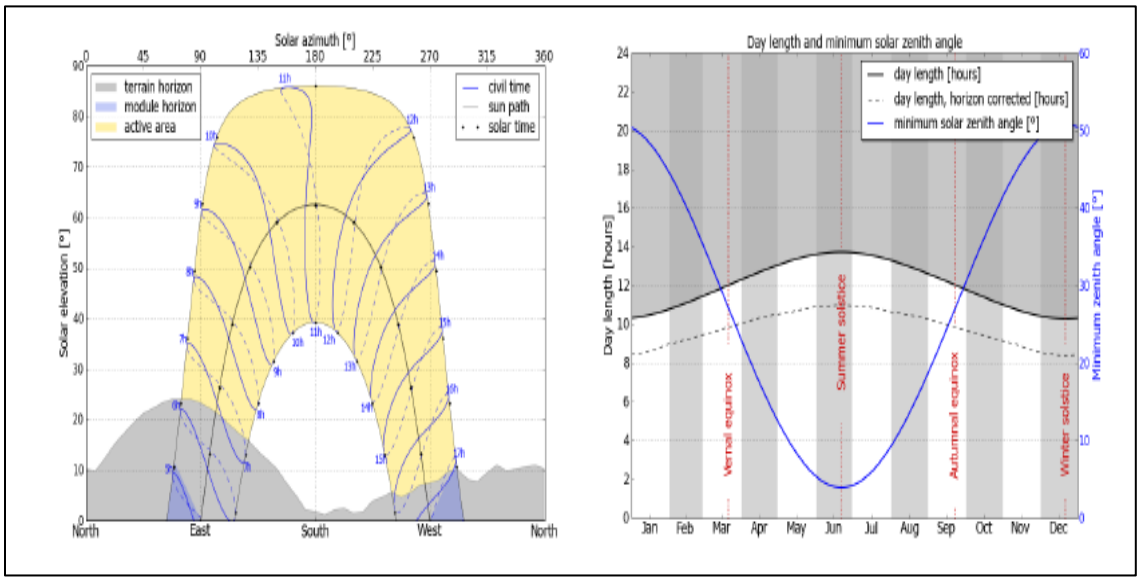

Figure 6: Terrain Horizon and day length

Global horizontal irradiation and air temperature

Month	Gh_m	Gh_d	Dh_d	T_{24}
Jan	97	3.12	1.52	6.6
Feb	99	3.52	1.96	7.7
Mar	130	4.20	2.50	11.0
Apr	137	4.55	2.82	14.7
May	144	4.65	2.96	17.3
Jun	122	4.06	2.89	19.1
Jul	120	3.86	2.77	19.3
Aug	121	3.90	2.70	19.5
Sep	116	3.85	2.42	18.2
Oct	134	4.32	1.90	15.4
Nov	104	3.48	1.48	11.4
Dec	95	3.07	1.40	8.2
Year	1417	3.88	2.28	14.1

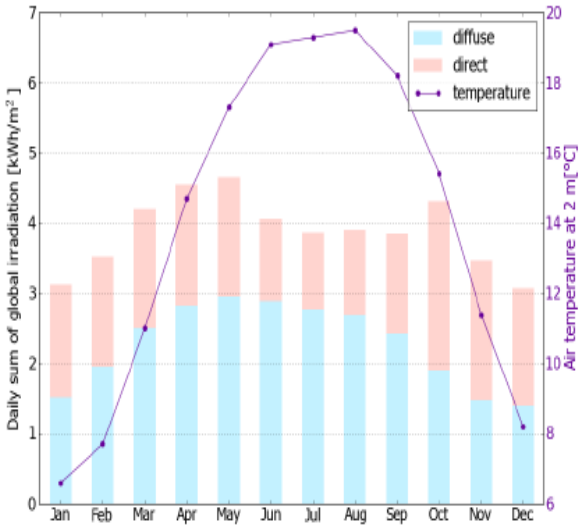

Figure 7: Global horizontal and air temperature

Global in-plane irradiation

Month	Gi_m	Gi_d	Di_d	Ri_d	Sh_{loss}
Jan	128	4.12	1.69	0.03	3.8
Feb	117	4.19	2.10	0.03	3.2
Mar	141	4.53	2.54	0.04	3.1
Apr	135	4.51	2.73	0.04	2.8
May	134	4.31	2.75	0.04	2.8
Jun	110	3.65	2.62	0.04	3.3
Jul	109	3.50	2.52	0.03	3.4
Aug	115	3.72	2.54	0.03	3.3
Sep	119	3.96	2.38	0.03	3.3
Oct	158	5.12	2.04	0.04	3.6
Nov	137	4.55	1.64	0.03	3.8
Dec	131	4.22	1.58	0.03	3.6
Year	1533	4.20	2.26	0.03	3.3

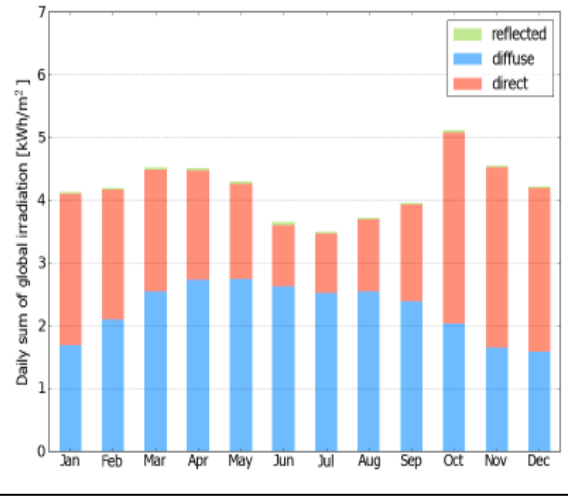

Figure 8: Global in-plane irradiation

Net Metering Business Model

The net metering based rooftop solar projects facilitate the self-consumption of electricity generated by the rooftop project and allows for feeding the surplus into the grid network of the distribution by licensee. The type of ownership structure for installation of such net metering based rooftop solar systems becomes an important parameter for defining the different rooftop solar models. A rooftop photovoltaic power station, or rooftop PV system, is a photovoltaic system that has its electricity-generating solar panels mounted on the rooftop Industry building. The various components of such a system include photovoltaic

modules, mounting systems, cables, solar inverters and other electrical accessories. Rooftop mounted systems are small compared to ground-mounted photovoltaic power stations with capacities in the megawatt range. A grid connected rooftop photovoltaic power station, the generated electricity can sometimes be sold to the servicing electric utility for use elsewhere in the grid. This arrangement provides payback for the investment of the installer. Many consumers from across the world are switching to this mechanism owing to the revenue yielded. A commission usually sets the rate that the utility pays for this electricity, which could be at the retail rate or the lower wholesale rate, greatly affecting solar power payback and installation demand.

3.2 Recommendation

As per the site feasibility study it was found that plant can install a 20 kWp Solar PV power plant which will generate an average of around 0.30 Lakhs electrical units annually. It is a grid connected net metering based rooftop solar system which is a new concept for MSME industries and in grid connected rooftop or small SPV system, the DC power generated from SPV panel is converted to AC power using power controller and is fed to the grid either of 33 kV/11 kV three phase lines or of 440V/220V three/single phase line depending on the local technical and legal requirements. These systems generate power during the day time which is utilized by powering captive loads and feed excess power to the grid. In case, when power generated is not sufficient, the captive loads are served by drawing power from the grid.

The net metering based rooftop solar projects facilitates the self-consumption of electricity generated by the rooftop project and allows for feeding the surplus into the network of the distribution licensee. The type of ownership structure for installation of such net metering based rooftop solar systems becomes an important parameter for defining the different rooftop solar models. In the international context, the rooftop solar projects have two distinct ownership arrangements.

3.3 Supplier Details

Table 9: Supplier Detail

Equipment Detail	Solar Rooftop 20 kWp
Supplier Name[2]	Subham Solar
Address	83, Bidhan Road , Paul Building Complex, 1st Floor, Silguri
Contact Person	Mr. Alok
Mail Id	info@subhamsolar.com
Phone No	+91 8348694520

[2] There is only supplier for Solar in Siliguri which is near to Gangtok

3.4 Savings

The expected savings by installation of 20 kWp solar roof top is 30,660 units of electricity annually. The annual monetary saving for this project is ***Rs 1.23 Lakhs with an investment of Rs 11.55 lakhs and payback for the project is 9.4 years.***

Detailed savings calculations is given in below table

Table 10: Savings Calculation

Parameters	UOM	
Proposed Roof top Solar installation	kW	20
Area Available in roof top	Sq ft	2000
Annual units generation per kW of Solar PV	kWh per kW/year	1533
Total Energy Generation Per Annum	kWh/year	30,660
Electricity Cost	Rs/kWh	4
Cost Savings	Rs Lakhs	1.20
Investment	Rs Lakhs	11.55
Payback period	Months	113

4. FINANCIAL ANALYSIS

4.1 Project Cost

Table 11: Project Cost

Parameter	Amount in Rs Lakhs
Solar Roof Top – 20 kWp Module	11
GST Charges @ 5%	0.55
Total Project Cost	**11.55**

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	11.55							
Energy Savings		1.23	1.25	1.28	1.30	1.33	1.35	1.38
O&M Cost		-0.58	-0.58	-0.58	-0.58	-0.58	-0.58	-0.58
Depreciation		4.6	2.8	1.66	1.0	0.6	0.4	0.2
Net Cash Flow	-11.55	5.27	3.45	2.36	1.72	1.35	1.14	1.02

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)	-11.55	4.8	2.8	1.8	1.2	0.8	0.6	0.5	0.9
NPV at CS 2 (50:50)	-11.55	4.7	2.8	1.7	1.1	0.8	0.6	0.5	0.6
NPV at CS 3 (100% Equity)	-11.55	4.6	2.6	1.6	1.0	0.7	0.5	0.4	-0.3

The IRR of the project is low because of the low electricity tariff of Rs 4/kWh. But still the plant is interested in implementing the project by considering it solar roof top as a green initiative and they can reduce the dependence on Grid electricity.

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)	0.9	-0.6	-2.2
NPV at CS2 (D50:E50)	0.6	-1.3	-2.7
NPV at CS3 (D0:E100)	-0.3	-1.6	-3.0
IRR	14%	8%	1%

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)	0.9	0.3	-0.3
NPV at CS2 (D50:E50)	0.6	0.0	-0.6
NPV at CS3 (D0:E100)	-0.3	-0.8	-1.4
IRR	14%	12%	9%

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)	1.3	1.1	1.1	0.93	0.86	0.79

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 20 kWp solar roof top would result in annual electricity savings of 30,660 units which is equivalent to 2.64 TOE per annum. The proposed EE measure will result in decrease of CO_2 emissions by 25.14 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 has 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 20 kWp 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 electricity savings of 30,660 units with 25.14 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
		kWh	TOE				
1	Solar Rooftop 20 kWp	30,660	2.64	1.23	11.55	113	25.14

The summary of financial analysis given in the below table clearly indicates that IRR is low. The main reason for the low IRR is due to electricity tariff of Rs 4/kWh which is much lower than the domestic tariff. But still the plant is ready to implement this project by considering solar as a green initiative and thereby reducing the dependence of Grid electricity. Also Sikkim Renewable Energy Development Agency, is also promoting the concept of renewable energy in Sikkim with the help of new schemes and subsidies that will benefit the end user. Even though the project financial is on lower side, the project is viable due to Govt. subsidies and polices for promoting RE in Sikkim.

Table 20: Financial Analysis

Sl. No.	Particulars	Unit	Value
i	Total Investment (Incl of Tax)	Rs. Lakh	**11.55**
ii	Means of Finance	Self / Bank Finance	**Self**
Iii	IRR	%	**13.85**
Iv	NPV at 70 % Debt	Rs. Lakh	**0.93**

7.1 Replication Potential

Solar Roof top 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

SUBHAM SOLAR SOLUTIONS PVT. LTD.
AN ISO 9001 : 2008 CERTIFIED COMPANY

83, Bidhan Road |Paul Building Complex |1st Floor | Siliguri-1
Ph. +91 353-2525624 / 2525671 / 672| Fax: 0353-2520130
E-mail: info@subhamsolar.com |Web: www.subhamsolar.com

Solar Energy Proposal

By : SUBHAM SOLAR SOLUTIONS PRIVATE LIMITED
Saturday, July 28, 2018

ISO 9001

Ministry of New and Renewable Energy

PV CYCLE

CE

Electrical
A detailed electrical design with single-line diagram and specifications will be prepared during full design phase after receiving the PO, for the client's approval.

G. SCOPE OF WORK
1. To conduct a detailed site visit with specialists to take accurate measurements, photographs, and other site-specific information for full design.
2. Prepare full system design to include civil, structural, electrical and mechanical components construction drawings and specifications.
3. Procure equipment and materials and deliver to site.
4. Perform complete system installation.
5. Test all electrical components in accordance with manufacturer instructions.
6. Commission the system to full operability.

H. CLIENT SCOPE
Site-specific considerations will require assistance and cooperation from
1. Provide access to work site for delivery of equipment and materials prior to and during project implementation.
2. Provide a suitable and secure space for storage of equipment and materials.
3. Facilitate access of work crew to the work site 7 days a week.
4. Facilitate interfacing with the client's resident engineering staff for consultation as needed.
5. All the Statutory clearances, if any, required for the Project work and goods transfer to site.
6. Weekly / Daily (as required) cleaning of solar module and cleaning arrangement.

I. PRICES

S.NO.	PRODUCT DESCRIPTION	Qty	Unit Rate/Kw	Amount
1	PCU 20KVA/360V/3-Phase BATTERY NAAh/NAV MODULE 20 Kwp Array Junction Box, GI structure, Cables & Installation & commissioning	1	₹ 55,000.00	₹ 1,100,000.00
	Sub Total		₹	1,100,000.00
	GST 5%		₹	55,000.00
	Freight		As Actual	
	Total Project Cost			1,155,000.00
Total Amount in Words =	**Eleven Lakhs Fifty Five Thousand Only**			
Other Terms & Conditions:				
Payment Terms: - 50% of the amount payable as advance along with Formal PO for a specific Solar System size. - Rest 50% against PI before dispatch.				
Delivery: Dispatch will be effected in 2-3 weeks from the date of acceptance of your Purchase order. (P.O) and receipt of advance. System installation will be completed in 3 weeks' time from date of receipt of materials at site, provided site is ready for installation.				
Validity: This offer is valid for 15 days from the date hereof.				