DETAILED PROJECT REPORT
ON
RENEWABLE ENERGY HARNESSING (7000 LPD SOLAR WATER HEATER) TECHNOLOGY
(GUJARAT DAIRY CLUSTER)










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RENEWABLE ENERGY HARNESSING (7000 LPD SOLAR WATER HEATER) TECHNOLOGY

GUJARAT DAIRY CLUSTER

BEE, 2010

Detailed Project Report on Renewable Energy Harnessing (7000 LPD Solar Water Heater) Technology
Gujarat Dairy Cluster, Gujarat (India)
New Delhi: Bureau of Energy Efficiency;
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Petroleum Conservation Research Association

Ahmedabad

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List of Abbreviation

BEE	Bureau of Energy Efficiency
CDM	Clean Development Mechanism
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
GHG	Green House Gases
IRR	Internal Rate of Return
NPV	Net Present Value
ROI	Return on Investment
SCM	Standard Cubic Meter
SIDBI	Small Industrial Development Bank of India
MoMSME	Ministry of Micro Small and Medium Enterprises
WHR	Waste Heat Recovery
SWHS	Solar Water Heating System

EXECUTIVE SUMMARY

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

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

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

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

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

S.No	*Particular*	*Unit*	*Value*
1	Project cost	(Rs. in Lakh)	8.56
2	Expected Electricity Savings	kWh/annum	0
3	Expected Other Savings	kg/year	13230

S.No	Particular	Unit	Value
4	Monetary benefit	(Rs. in Lakh)/annum	3.97
5	Debit equity ratio	Ratio	3:1
6	Simple payback period	Yrs	2.15
7	NPV	(Rs. in Lakh)	6.65
8	IRR	%age	31.22%
9	ROI	%age	26.25
10	DSCR	Ratio	1.99
11	Process down time	Days	7

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

ABOUT BEE'S SME PROGRAM

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

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

Activity 1: Energy use and technology audit

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

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

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

Activity 3: Implementation of energy efficiency measures

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

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

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

1 INTRODUCTION

1.1 Brief introduction about cluster

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

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

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

Table 1.1 Details of annual energy consumption

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

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

b) A Typical Milk Chilling Center

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

Classification of Units

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

- Milk Chilling Center
- Dairy Units

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

Products Manufactured

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

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

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

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

Table 1.2 Details of types of product manufactured

Details of units of cluster subjected to Preliminary Energy Audit.

S.No.	Particulars of SME	Dairy / Chilling Center	Production Capacity in ltrs/day
1	Unit 1	Dairy	25000
2	Unit 2	Dairy	14500
3	Unit 3	Dairy	9000

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

Energy usages pattern

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

The details of energy uses pattern are as given below-

Table 1.3 Energy usages pattern

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

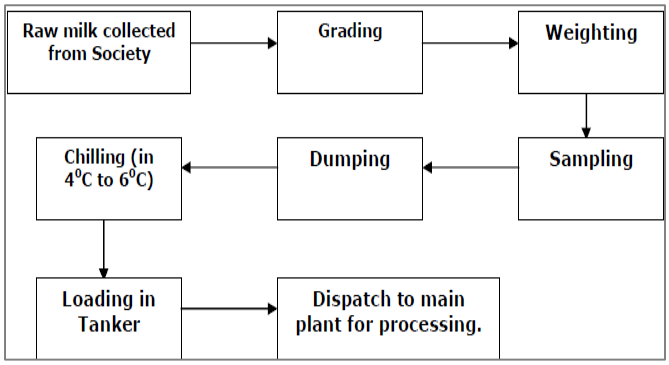
Name of Unit	Electricity	FO	PNG	Wood	HSD	LDO	Other
Unit 12	☼	☼					
Unit 13	☼			☼			
Unit 14	☼			☼			
Unit 15	☼	☼					
Unit 16	☼	☼	☼				
Unit 17	☼			☼			
Unit 18	☼	☼	☼				☼ (Castor DOC)
Unit 19	☼			☼ (Saw Mill Dust)			☼ (Steam from Outside)
Unit 20	☼	☼					
Unit 21	☼	☼					
Unit 22	☼	☼					

General production process for Dairy cluster

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

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

Process Diagram for Typical Milk Chilling Center



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

Pasteurization

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

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

Homogenization

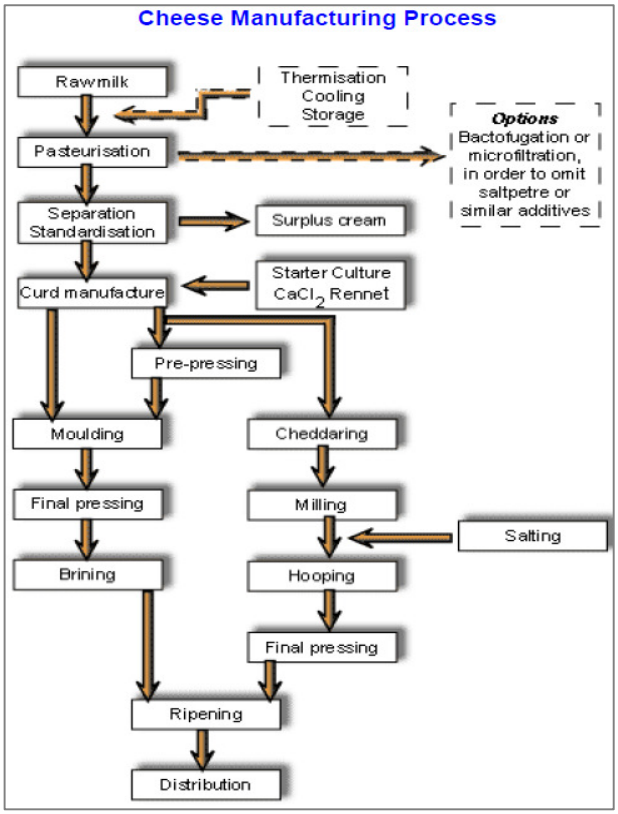
Milk must then be homogenized. Without homogenization, the milk fat would separate from the milk and rise to the top. Milk fat is what gives milk its rich and creamy taste. Homogenization makes sure that the fat is spread out evenly in the milk so that every sip of milk has the same delicious flavor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

Packaging Milk

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

Cream Extraction & Butter

Milk cream is extracted from Milk using centrifuge. The butter making process involves quite a number of stages. The continuous butter maker has become the most common type of equipment used. The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer. The cream should be sweet (pH >6.6, TA = 0.10 - 0.12%), not rancid and not oxidized. If the cream is separated by the butter manufacturer, the whole milk is preheated to the required temperature in a milk pasteurizer before being passed through a separator. The cream is cooled and led to a storage tank where the fat content is analyzed and



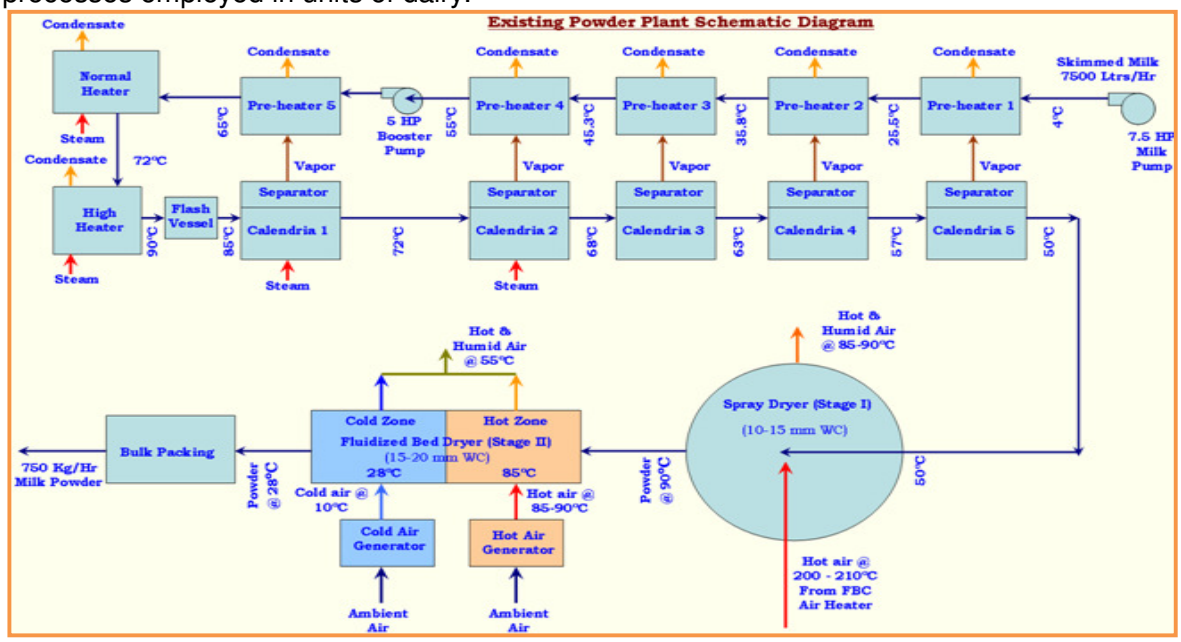
adjusted to the desired value, if necessary. The skim milk from the separator is pasteurized and cooled before being pumped to storage. It is usually destined for concentration and drying. From the intermediate storage tanks, the cream goes to pasteurization at a temperature of 95oC or more. The high temperature is needed to destroy enzymes and micro-organisms that would impair the keeping quality of the butter.

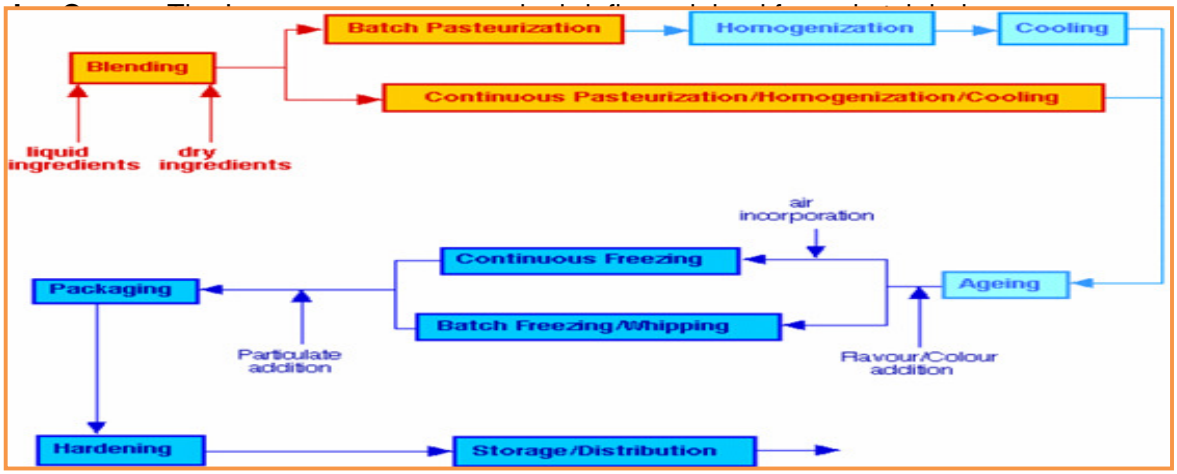
Cheese

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

Milk Powder

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





1.2 Energy performance in existing system

1.2.1 Fuel consumption

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

Table 1.4 Average fuel and electricity consumption

a) On Mcal Basis

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

b) On Cost Basis

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

1.2.2 Average annual production

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

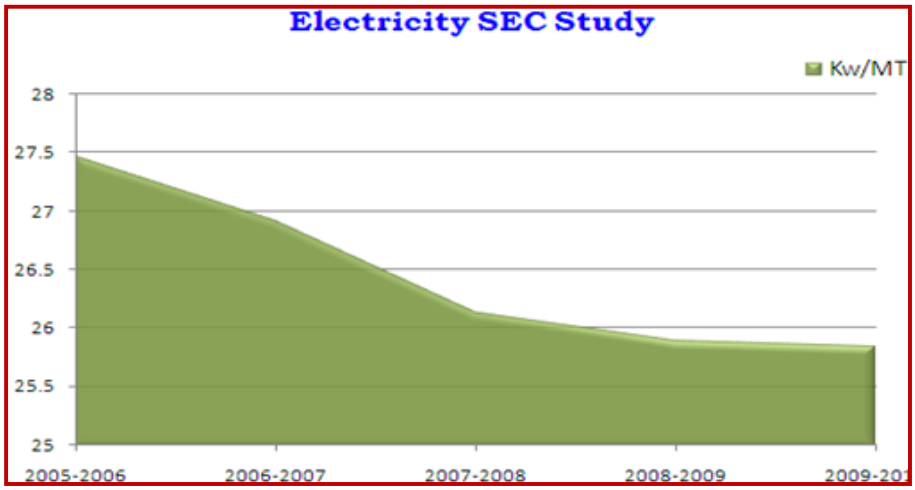
1.2.3 Specific energy consumption

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

Table 1.5 Average annual production

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

Electricity SEC Study in Dairy Cluster over Past Few Years



Thermal Energy SEC Study in Dairy Cluster over Past Few Years

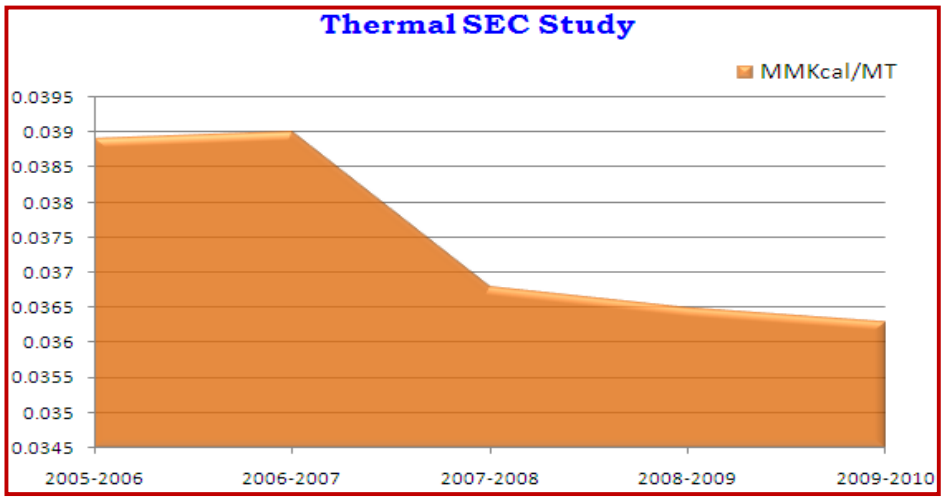


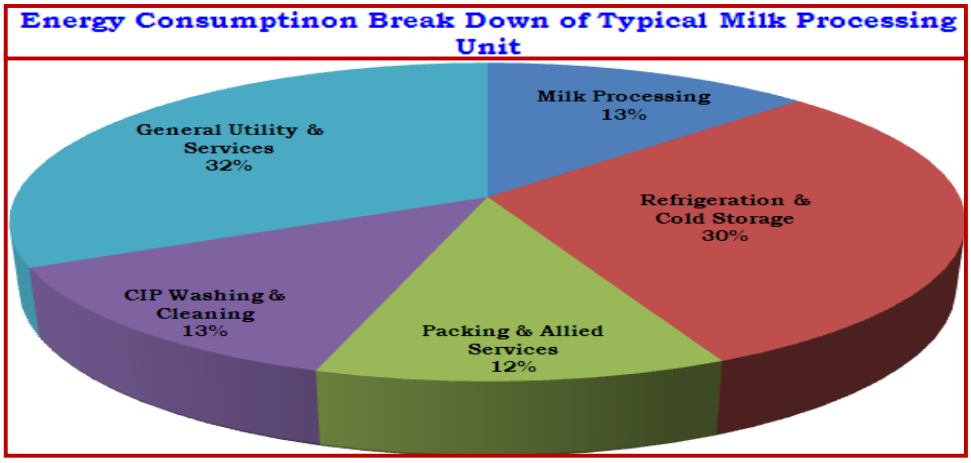
Figure 1.1 SEC Study in Dairy Cluster over Past Few Years

Process (Main Equipments) wise cost of energy consumption

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

Table 1.6 Process wise (Main Equipment) wise cost of energy consumption

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



1.3 Existing technology/equipment

1.3.1 Description of existing technology

Currently for hot water requirements for various purposes like, CIP requirement, hot water generators are provided. Additional fuels such as FO, PNG, Wood, HSD etc are consumed for hot water generator.

Other hot requirements can be like, make up water preheating, can washing machine etc. The hot water requirement of any milk chilling center or dairy is substantially high.

Energy charges

Table 1.7 Energy charges

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

Demand Charges

Table 1.8 Demand charge

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

Therefore, total electricity Charges (including the maximum demand charges & other taxes) is Rs. 6.12 per kWh in considered case.

1.3.2 Role in process

The very purpose of the chilling centre is to chill the raw milk received from distant societies & transport it to the main dairy. Hot requirements can be like, make up water preheating, can washing machine etc. The hot water requirement of any milk chilling center or dairy is substantially high.

1.4 Baseline establishment for existing technology

Typical unit is a dairy, a milk chilling center which collects, carries weighing, chills the milk, cleans the cans & sends the milk to mother dairy. This plant on an average receives 150000 Liters/Day of raw milk from the nearby villages. Currently per annum 974664 kWh are consumed, FO consumption is 63036 Kg/Annum. By providing the solar water heater of 7000 LPD Capacity, FO up to 13230 Kgs/Annum can be saved.

Table 1.9 Baseline Establishment for Existing Technology

SN	Quantity of Hot water available from Solar Water Heater per Day	Expected Temperature of Hot water	Purpose of Utilization of Hot Water	Total Heat Captured from heater (Considering ambient 27°C)	Expected FO saving per day
1)	7000 LPD	70 to 85°C	CIP Requirements, Makeup water pre-heating	301000 kcal/Day	44.1 kg/day

Thus existing base line loss can be computed as per above given table. Existing actual consumption if FO is 1225 kg/day, which means, 442020 kg per Annum.

1.4.1 Design and operating parameters

Many of the existing most of the Milk chilling center / Dairies are provided with solar water heater and working successfully.

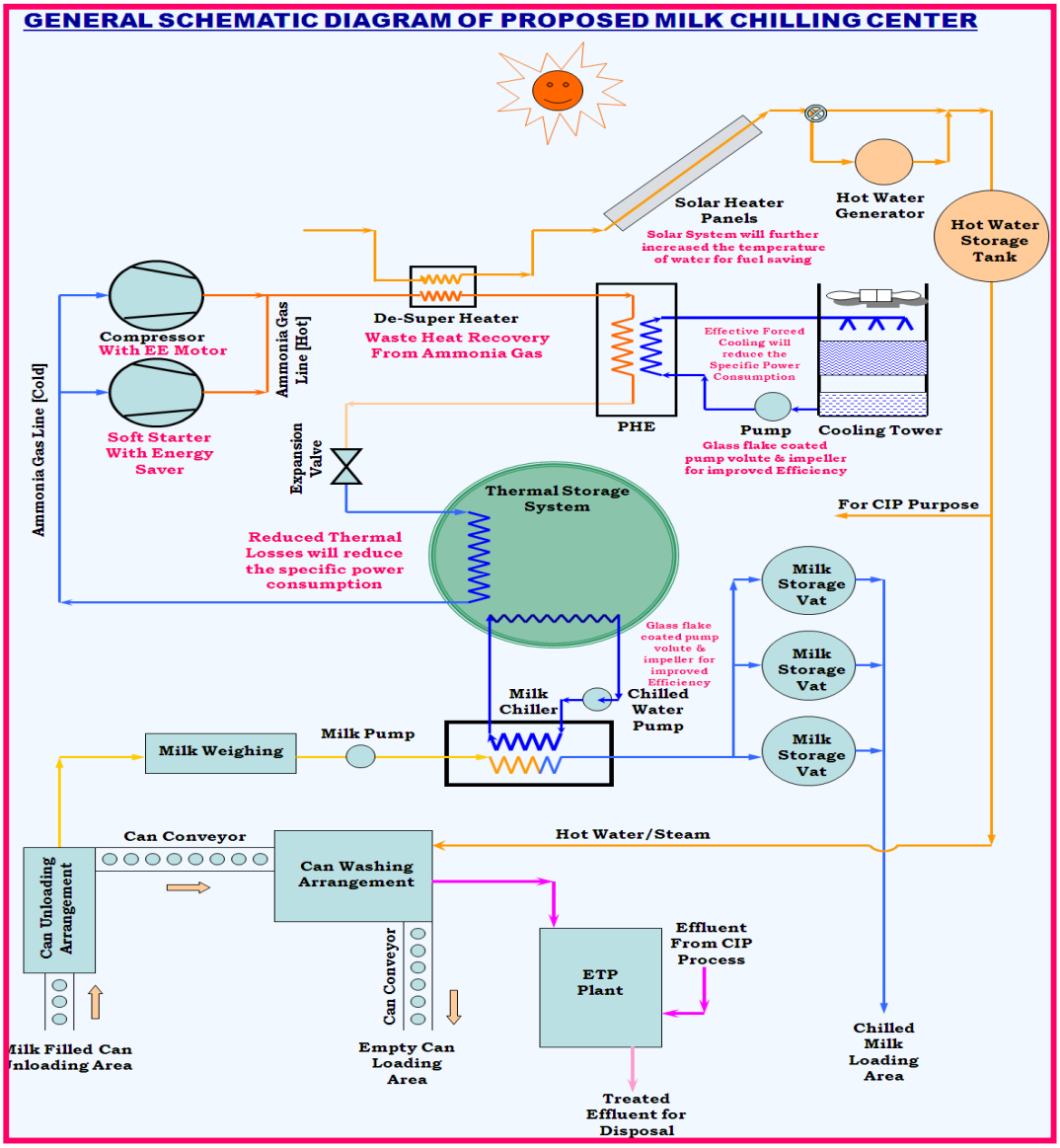
Hot water and steam form an integral part of various industrial and commercial applications and with rising oil prices, there has never been a better time to look at heating water by harnessing energy from the Sun.

Principle of Heating Water through Solar:

The technology to heat water using solar energy is based on two simple principles:

- Thermo-siphon action: Is based on a simple principle that hot water is less dense and hence tends to rise above colder water.

- Black body absorption: It is a well known fact that a black body absorbs heat which can be used to heat water.
- The Sun's rays heats the black powder coated copper fins (larger surface area) which in turn heats the cold water in the copper tubes. The heated water slowly rises in the copper pipes thro thermo-siphon action and eventually gets stored in the hot water storage tank.
- This principle ensures that no electricity is used in the entire system.



1.5 Barriers in adoption of proposed equipment

1.5.1 Technological barrier

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

However the first change is still a challenge, upon success, later on duplication and adaptation is extremely prevalent in the cluster. The technologies need to be demonstrated within the cluster. While carrying out the audits and presenting the Energy audit reports to the units, in the discussion with the plant owners & other personnel, many of them agreed with many of the identified energy saving measures and technologies but they demanded demonstration of the energy saving technologies in any plant and thereafter they have readiness to follow.

Milk chilling centers and dairy plants are using conventional technology. The design and operation of the plant is standardized as per old practices. It was fine, till energy was available relatively cheap and there was no global drive to better energy management.

While carrying out the audits and presenting the Energy audit reports to the units, it was found that significant energy can be saved by provision of De-super heater system. And hence there is a need for a better technology for efficient energy management.

1.5.2 Financial barrier

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

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

1.5.3 Skilled manpower

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

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

1.5.4 Other barrier (If any)

Lack of awareness regarding LCC (Life cycle cost) concept is the biggest barrier. The management of dairy still gives importance to initial investment required for solar water heaters than study of total life cycle cost.

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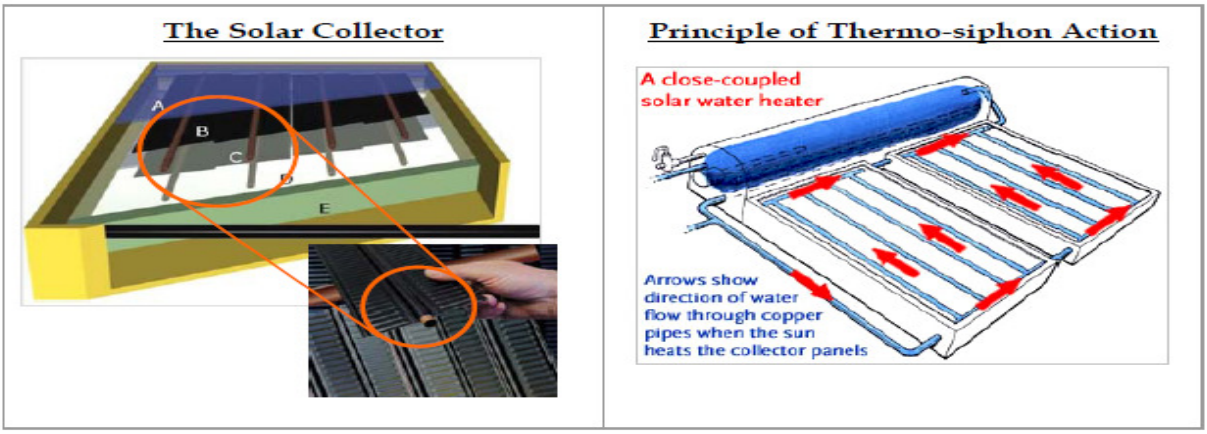
2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

As explained earlier, substantial amount of hot water required for dairy unit which is generated by using fossil fuel. Solar water heater generates hot water by using solar energy and reduces consumption of fossil fuels.

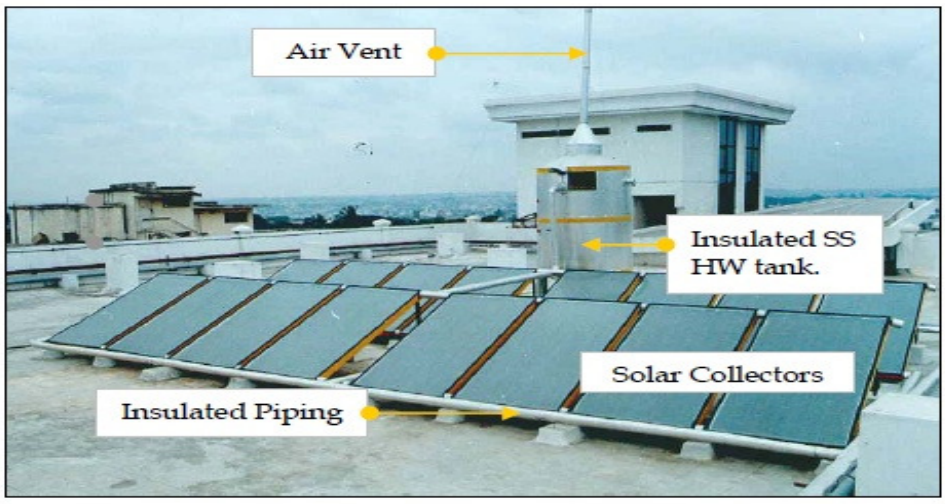
Solar Collector:

- A collector consists 9 copper tubes (C) with copper fins (B) encased in an aluminum box (usually powder coated in yellow) with a glass top (A).
- The quality of copper used by Tata BP Solar is 99.9% pure electrolytic copper with selective coating using 'Black chrome technology'.
- A reflective surface at the bottom (D) and rock-wool ensures that any energy that passes between the fins gets reflected back onto the copper fins to ensure optimum performance in any condition.
- The collectors measure approximately 2m x 1m and are fixed at an angle (w.r.t to the horizontal equal to the latitude of the site) facing the South sky in a shadow free flat surface area.



The main components of a typical Solar Water Heating System are:

- Solar Collectors: functions as the primary heating source.
- Insulated SS 304 hot water tank: for storing hot water.
- Insulated piping: regulate flow of water between components.
- Air vent: to release trapped air from hot water tank.



Typical 'Solar Water Heating System' (SWHS) components.

2.1.1 Details of proposed equipment

Comparison with two prominent type Solar Water Heaters

Feature	Flat Plate Collector	Evacuated Tube Collector
Front View		
Absorber	9 nos. of selective Coated copper fins and riser tubes	No Copper fin & rise tube. Inner surface of glass tube has Al-N/Al Coating.
Type of Glass	4 mm thick toughened glass	Borosilicate glass tube.
Pressure withstanding capacity	Good, up to 6 bar	Cannot withstand pressure of more than 0.3 bar due to glass rubber joint.
Capacity to absorb both Direct & Indirect radiations	Yes	No
Net absorber area (for 100 lit) M²	1.95	1.23
Height (100 LPD) mm	1800	1300
System Area	1.3 m x 2.3 m	1.3 m x 1.7 m
ISI Certification	Yes	No
Maintenance	Easy	Careful
Serviceability	Yes	Yes

Feature	Flat Plate Collector	Evacuated Tube Collector
Life	Above 10 years	Upto 10 Years
Efficiency	51%	31.60%

2.1.2 Equipment/technology specification

READY RECKONER: *(Assumed at 10 collectors per 1000 lpd to heat water to 80 ° C)*

Capacity lpd	Total no. of collectors	Area - 80°C Sqm	Elec Savings (Units/day)	Savings/Yr (@Rs5/Unit)	Savings/Yr (Diesel)*
1000	10	35	45	67,500	52,500
2000	20	70	90	135,000	105,000
3000	30	105	135	202,500	157,500
4000	40	140	180	270,000	210,000
5000	50	175	225	337,500	262,500
6000	60	210	270	405,000	315,000
7000	70	245	315	472,500	367,500
8000	80	280	360	540,000	420,000
9000	90	315	405	607,500	472,500
10000	100	350	450	675,000	525,000
15000	150	525	675	1,012,500	787,500
20000	200	700	900	1,350,000	1,050,000
25000	250	875	1125	1,687,500	1,312,500
30000	300	1050	1350	2,025,000	1,575,000

Table to calculate no. of collectors (No. of collectors per 1000 liters):

	Cold climates & N. India	*Rest of India*
For 60 ° C	10	8
For 70 ° C	12	10
For 80 ° C	15	12

TOTAL FLAT/ROOF AREA required for installing SWHS *(in sqm)*:

$$\left(\frac{\text{Total volume of Hot Water required (in litres per day)}}{1000}\right) \times \text{No. of collectors} \times 3.5\text{sqm}$$

from table above.

Notes:

- *3.5 sqm assumes area required per collector, interconnecting insulated piping between collectors & hot water storage tank fixed vertically.*
- *1 sqm ~ 10.75 sq ft or 3.5 sqm ~ 37.5 sqft.*

Energy Savings:

For every 1000 liters of water heated from room temperature (25°C) to 80°C, approximate equivalent energy savings per day are as follows:

• Electricity: 45 Units	• Diesel: 5.3 lts
• Gas: 5.5 kgs	• Firewood: 31 kgs

2.1.3 Integration with existing equipment

The energy conservation proposal is of the additional equipment type; only minor change in piping arrangement along with provision of hot water storage tank has to be made. The new solar water heater system can be fully integrated with existing system without any problem.

2.1.4 Superiority over existing system

Use of this renewable source based water heating technology reduces the overall plant energy cost. It also reduces the dependency for electricity on the state electricity grid or fuel requirement for hot water generator. The proposed measure bears better technology than the existing one resulting in both energy saving, utilization of renewable source of energy & technological up gradation.

2.1.5 Source of equipment

The recommended technology is proven one and in various industries on normal basis. These are running successfully and the unit owners had observed the savings in terms of energy.

2.1.6 Availability of technology/equipment

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

2.1.7 Service providers

Details of technology service providers are shown in Annexure 7.

2.1.8 Terms and conditions in sales of equipment

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

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

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

2.1.9 Process down time

Process down time of Milk Chilling Unit of about 1 week maximum will be required for the interconnection of the solar water heater with the existing system.

2.2 Life cycle assessment and risks analysis

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

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

2.3 Suitable unit for implementation of proposed technology

The measure & technology is suitable for the milk chilling center & dairy units under the Gujarat Dairy Cluster & similar units outside cluster. This measure in fact will result in technological up gradation in vital energy consuming area of these units.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 Technical benefit

3.1.1 Fuel saving

It is estimated that this system will save 13230 kg FO per annum (9.03 KLOE per Annum) for the unit. And the details are furnished in the following table 'Table 3.1'.

3.1.2 Electricity saving

There is no electricity saving ***directly or indirectly***.

3.1.3 Improvement in product quality

The measures do not have any impact on quality of product ***directly or indirectly***.

3.1.4 Increase in production

Production will be the same as in present.

3.1.5 Reduction in raw material

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

3.1.6 Reduction in other losses

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

3.2 Monetary benefits

Implementation of project will result in good, consistent monetary benefit. It is estimated that this system will save FO on an average 13230 Kg/Annum will be saved for the unit.

Please refer following table.

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

S. no.	Parameter	Unit	Value
1)	Expected Saving of Fuel per Annum (Considering effective full working day for solar system to be 300 days only)	Kg/Annum	13230
2)	Expected Saving in Rs/Annum	Rs./Annum	396900
3)	Expected Investment for Solar Heating System with Insulated Storage Tank, Pipe lines and associated insulation	Rs./Machine	856000
4)	KLOE Saving per Annum	KLOE/Annum	9.03

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

3.3 Social benefits

3.3.1 Improvement in working environment

Use of Solar Water Heater in Dairy Industry reduces the energy consumption, and also improves efficiency of unit and reduces CO_2 generation.

3.3.2 Improvement in workers skill

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

3.4 ENVIRONMENTAL BENEFITS

3.4.1 Reduction in effluent generation

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

3.4.2 Reduction in GHG emission

Implementation of this technology will reduce the CO_2 emissions. Reduction in CO_2 emissions will be possible due to Energy saving. Hence it will help in reducing CO_2 emission up to 45 tonnes per year.

3.4.3 Reduction in other emissions like SO_X

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

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of project

4.1.1 Equipment cost

Cost of the solar heater including installation, erection & commissioning is Rs.8.56 Lacs per 7000 LPD System.

4.1.2 Erection, commissioning and other misc. cost

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

Table 4.1 Details of proposed technology project cost

Details of Proposed Technology Project Cost			
SN	**Particulars**	**Unit**	**Value**
1	Cost of Retrofit/Additional Plan & Machinery For Energy Saving	(in Lacs)	7.35
2	Detail Engineering, Design & related expenses	(in Lacs)	0.3
3	Erection & Commissioning cost	(in Lacs)	0.8
4	Cost of civil work	(in Lacs)	0.2
5	Custom Clearance & Transportation Charges	(in Lacs)	0
6	Import duty	(in Lacs)	0
7	Other charges (Including Contingency 10%)	(in Lacs)	0.09
	Total cost	(in Lacs)	8.56

4.2 ARRANGEMENTS OF FUNDS

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost i.e. Rs. 2.14 Lakh & financial institutes can extend loan of 75%.

4.2.2 Loan amount.

The term loan is 75% of the total project cost i.e. Rs. 6.42 Lakh, with repayment of 5 years considered for the estimation purpose.

4.2.3 Subsidy by Government

Currently no state govt. subsidy is applicable to such project. The units may check the availability of subsidy in future for any policy changes. MNRE (Ministry Of New and Renewable Energy) provides wide range of opportunities & incentives for Technology & Quality Upgradation Support to Micro, Small & Medium Enterprises for various Industries. The details are available in the Quotation in Annex-8.

4.2.4Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 FINANCIAL INDICATORS

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

The project is expected to achieve monetary savings of Rs. 3.97 lakh per year.

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

Considering the above mentioned assumptions, the net cash accruals starting with Rs. 2.58 lakh in the first year operation and Rs. 13.49 lakh at the end of eighth year.

4.3.2 Simple payback period

The Simple Payback period is about 2.15 years or about 26 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be 6.65 lakh

4.3.4 Internal rate of return (IRR)

The after tax IRR of the project works out to be 31.22%. Thus the project is financially viable for both types of fuels.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 26.25%.

Financial indicator of proposed technology is furnished in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology/equipment

SN	Scenario	IRR	NPV	ROI	DSCR
1	Normal	31.22%	6.65	26.25	1.99

4.4 SENSITIVITY ANALYSIS

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

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

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

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

Table 4.3 Sensitivity analysis at different scenarios

SN	Scenario	IRR	NPV	ROI	DSCR
1	Normal	31.22%	6.65	26.25	1.99
2	5% Increase in Fuel Saving	33.47%	7.41	26.47	2.09
3	5% Decrease in Fuel Saving	28.95%	5.89	26.01	1.89

4.5 PROCUREMENT AND IMPLEMENTATION SCHEDULE

Procurement and implementation schedule for proposed project are shown in Table 4.4 below and further details of process break down are shown in Annexure 6. The project will take about 3 weeks in all two week for order placement and delivery and the other for installation. For distance areas it would take 4 to 5 weeks. 3 to 4 weeks would be there for order placement and delivery.

Table 4.4 Procurement and implementation schedule

S.no.	Activities	Weeks			
		1	2	3	4
1	Order Placement				
2	Delivery				
3	Connecting New & Existing Pipelines				
4	Hydrostatic Testing Of Pipeline				
5	Thermal Insulation				
6	Training				

Annexure

Annexure -1: Energy audit data used for baseline establishment

By providing the Solar water heater of 7000 LPD Capacity, FO up to 13230 Kgs/Annum can be saved.

SN	Quantity of Hot water available from Solar Water Heater per Day	Expected Temperature of Hot water	Purpose of Utilization of Hot Water	Total Heat Captured from heater (Considering ambient 27°C)	Expected FO saving per day
1)	7000 LPD	70 to 85°C	CIP Requirements, Makeup water pre-heating	301000 Kcal/Day	44.1 kg/day

Thus existing base line loss can be computed as per above given table. Existing actual consumption if FO is 1225 kg/day, which means, 442020 kg per Annum.

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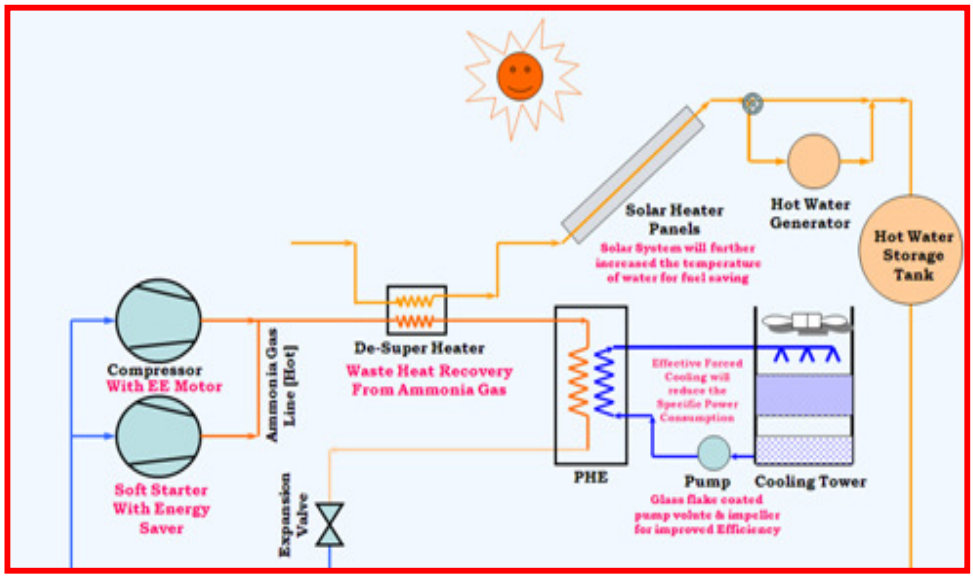
Annexure -2: Process flow diagram after project implementation



The process flow will not change. The only change will be the CIP water supply will be routed through the solar water heater

Demand side Schematic diagram of Solar heater System :

Please refer the following diagram. The hot water from Solar Water heater can be utilized for various purposes like CIP requirements, for boiler makeup water preheating & various other hot water requirements.

Please refer diagram below from Annexure-2 for process diagram after project implemented.

Annexure -3: Detailed technology assessment report

The details of cost benefit analysis are as given below –

S. no.	Parameter	Unit	Value
1]	Heat energy saved by providing solar water heater (7000 Ltrs/Day capacity providing hot water at 70˚C from ambient water temperature from 27˚C)	kCal/Day	301000
2]	Fuel used currently for hot water generator		FO
3)	Calorific Value of currently used fuel	kCal/Kg	10500
4)	Specific Gravity Considered for Fuel		0.9
5)	Expected Saving of Currently used fuel considering hot water generator eff. Of 65%	Kg/Day	44.1
6)	Cost of Fuel on day of computation	Rs./Kg	30
7)	Expected Saving of Fuel per Annum (Considering effective full working day for solar system to be 300 days only)	Kg/Annum	13230.77
8)	Expected Saving in Rs/Annum	Rs./Annum	396900
9)	Expected Investment for Solar Heating System with Insulated Storage Tank, Pipe lines and associated insulation	Rs./System	856000
10)	Simple Payback Period	Yrs	2.15
		Months	26
11)	KLOE Saving per Annum	KLOE/Annum	9.03

Annexure -4 Drawings for proposed electrical & civil works

No additional major civil work is required. No Change in electrical layout.

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Annexure -5: Detailed financial analysis

Name of the Technology	SOLAR WATER HEATING SYSTEM		
Rated Capacity	**7000 LPD**		
Details	**Unit**	**Value**	**Basis**
Installed Capacity	LPD	7000	
No of working days	Days	300	
No of Shifts per day	Shifts	1	
Proposed Investment			
Plant & Machinery	Rs. (in lakh)	7.65	
Civil Work		0.02	
Erection & Commissioning	Rs. (in lakh)	0.80	
Investment without IDC	Rs. (in lakh)	8.47	
Misc. Cost	Rs. (in lakh)	0.09	
Total Investment	Rs. (in lakh)	8.56	
Financing pattern			
Own Funds (Equity)	Rs. (in lakh)	2.14	Feasibility Study
Loan Funds (Term Loan)	Rs. (in lakh)	6.42	Feasibility Study
Loan Tenure	Years	5.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	66.00	Assumed
Interest Rate	%age	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	2.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
FO Saving	Kgs/Annum	13230	
Cost of fuel	Rs./Kgs	30	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	6.42	0.48	5.94	0.74
2	5.94	0.96	4.98	0.55
3	4.98	1.20	3.78	0.44
4	3.78	1.44	2.34	0.31
5	2.34	1.59	0.75	0.17
6	0.75	0.75	0.00	0.02
		6.42		

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

Particulars / years	1	2
Plant and Machinery		
Cost	8.56	1.71
Depreciation	6.85	1.37
WDV	1.71	0.34

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

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97
Total Revenue (A)	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97
Expenses								
O & M Expenses	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24
Total Expenses (B)	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.24
PBDIT (A)-(B)	3.80	3.79	3.78	3.77	3.76	3.75	3.74	3.73
Interest	0.74	0.55	0.44	0.31	0.17	0.02	0.00	0.00
PBDT	3.06	3.24	3.34	3.46	3.59	3.73	3.74	3.73
Depreciation	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
PBT	2.60	2.79	2.88	3.01	3.14	3.28	3.29	3.28
Income tax	0.00	0.64	1.13	1.18	1.22	1.27	1.27	1.27
Profit after tax (PAT)	2.60	2.15	1.75	1.83	1.92	2.01	2.02	2.01

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

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	2.60	2.79	2.88	3.01	3.14	3.28	3.29	3.28
Add: Book depreciation	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Less: WDV depreciation	6.85	1.37	-	-	-	-	-	-
Taxable profit	(3.79)	1.87	3.34	3.46	3.59	3.73	3.74	3.73
Income Tax	-	0.64	1.13	1.18	1.22	1.27	1.27	1.27

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

Particulars / Years	1	2	3	4	5	6	7	8
Share Capital (D)	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14
Reserves & Surplus (E)	2.60	4.76	6.51	8.34	10.26	12.27	14.28	16.29
Term Loans (F)	5.94	4.98	3.78	2.34	0.75	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	10.68	11.88	12.43	12.82	13.15	14.41	16.42	18.43
Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	8.56	8.56	8.56	8.56	8.56	8.56	8.56	8.56
Less Accm. Depreciation	0.45	0.90	1.36	1.81	2.26	2.71	3.16	3.62
Net Fixed Assets	8.11	7.66	7.20	6.75	6.30	5.85	5.40	4.94
Cash & Bank Balance	2.58	4.22	5.22	6.07	6.85	8.56	11.03	13.49
TOTAL ASSETS	10.68	11.88	12.43	12.82	13.15	14.41	16.42	18.43
Net Worth	4.74	6.90	8.65	10.48	12.40	14.41	16.42	18.43
Debt Equity Ratio	2.78	2.33	1.77	1.09	0.35	0.00	0.00	0.00

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

Particulars / Years	0	1	2	3	4	5	6	7	8
Sources									
Share Capital	2.14	-	-	-	-	-	-	-	-
Term Loan	6.42								
Profit After tax		2.60	2.15	1.75	1.83	1.92	2.01	2.02	2.01
Depreciation		0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45

Total Sources	8.56	3.06	2.60	2.20	2.28	2.37	2.46	2.47	2.46
Application									
Capital Expenditure	8.56								
Repayment Of Loan	-	0.48	0.96	1.20	1.44	1.59	0.75	0.00	0.00
Total Application	8.56	0.48	0.96	1.20	1.44	1.59	0.75	0.00	0.00
Net Surplus	-	2.58	1.64	1.00	0.84	0.78	1.71	2.47	2.46
Add: Opening Balance	-	-	2.58	4.22	5.22	6.07	6.85	8.56	11.03
Closing Balance	-	2.58	4.22	5.22	6.07	6.85	8.56	11.03	13.49

IRR **Rs. (in lakh)**

Particulars / months	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Profit after Tax		2.60	2.15	1.75	1.83	1.92	2.01	2.02	2.01
Depreciation		0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Interest on Term Loan		0.74	0.55	0.44	0.31	0.17	0.02	-	-
Cash outflow					-	-	-	-	-
Net Cash flow	(8.56)	-	-	-	-	-	-	-	-
IRR	31.22								

NPV	6.65

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

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.13	0.13	0.14	0.15	0.16	0.16	0.17	0.18
Sub Total(G)	0.13	0.13	0.14	0.15	0.16	0.16	0.17	0.18
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.04	0.04	0.05	0.05	0.05	0.05	0.06	0.06
Interest on Term Loan	0.74	0.55	0.44	0.31	0.17	0.02	0.00	0.00
Depreciation (H)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Sub Total (I)	1.24	1.05	0.94	0.81	0.67	0.53	0.51	0.51
Sales (J)	3.97	3.97	3.97	3.97	3.97	3.97	3.97	3.97
Contribution (K)	3.84	3.83	3.83	3.82	3.81	3.81	3.80	3.79
Break Even Point (L= G/I)	32.18%	27.31%	24.62%	21.30%	17.58%	13.91%	13.41%	13.52%
Cash Break Even {(I)-(H)}	20.41%	15.52%	12.82%	9.47%	5.72%	2.03%	1.51%	1.59%
Break Even Sales (J)*(L)	1.28	1.08	0.98	0.85	0.70	0.55	0.53	0.54

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

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Net Profit Before Taxes	2.60	2.79	2.88	3.01	3.14	3.28	3.29	3.28	24.27
Net Worth	4.74	6.90	8.65	10.48	12.40	14.41	16.42	18.43	92.43
									26.25%

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

Particulars / Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Cash Inflow									
Profit after Tax	2.60	2.15	1.75	1.83	1.92	2.01	2.02	2.01	12.27
Depreciation	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	2.71
Interest on Term Loan	0.74	0.55	0.44	0.31	0.17	0.02	0.00	0.00	2.24
Total (M)	3.80	3.15	2.65	2.60	2.54	2.48	2.47	2.46	17.22

DEBT

Interest on Term Loan	0.74	0.55	0.44	0.31	0.17	0.02	0.00	0.00	2.24
Repayment of Term Loan	0.48	0.96	1.20	1.44	1.59	0.75	0.00	0.00	6.42
Total (N)	1.22	1.51	1.64	1.75	1.76	0.77	0.00	0.00	8.66
	3.11	2.09	1.61	1.48	1.45	3.21	0.00	0.00	1.99
Average DSCR (M/N)	1.99								

Annexure:-6 Procurement and implementation schedule

Procurement and implementation schedule for proposed project are shown in Table 4.4 below and further details of process break down are shown in Annexure 6. The project will take about 2 weeks in all one week for order placement and delivery and the other for installation. For distance areas it would take 4 to 5 weeks. 3 to 4 weeks would be there for order placement and delivery.

S.no.	Activities	Days						
		1	2	3	4	5	6	7
1.	Connecting New & Existing Pipelines							
2.	Hydrostatic Testing Of Pipeline							
3.	Thermal Insulation							
4.	Training							

Note: - Before actual stopping the process, the 7000 LPD solar water system will be installed. The pipe line will be extended near points where new system will be integrated with existing one.

During actual down time

- First 3 day will be required for making pipe connections of new system with existing system. Simultaneously the minor civil grouting will be carried for pipe line support.
- Hydrostatic testing of pipe line will require 2 days.
- Additional 2 days will be required for thermal insulation, training etc which simultaneously starts on the second day of the hydrostatic testing of pipelines.

Annexure -7: Details of technology service providers

S.No.	Name of Service Provider	Address	Contact Person and No.
1	Urmi Solar Systems Ltd	Plot No: 2113, Phase-III, GIDC, Vatva, Ahmedabad-382445	Harshad Patel Mob. + 91 09426010911, 099 78 541 876 info@urmisolar.com urmisolarheater@yahoo.co.in Website: www.urmisolar.com

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

URMI SOLAR SYSTEMS LTD
Plot No: 2113, Phase-III, GIDC, Vatva, Ahmedabad-382445
Email: info@urmisolar.com/urmisolarheater@yahoo.co.in
Website: www.urmisolar.com

USSL/**AGRAWAL**/10-11/383 Date: 15-Mar-11

To,
PCRA Ahmedabad

Sub: Quotation for "URMI" Solar Water Heating System

Site: For Dairy in Gujarat

Dear Sir,

This has reference to tele talked with under signed yesterday for your requirement of Solar Water Heating System.

URMI SOLAR SYSTEMS Ltd is a leading manufacturer of solar thermal devices like solar water heating systems, solar Air heating & solar distillation systems since 1986. Comprising of highly spirited team of engineers and employees, we have installed 2500 systems with total capacity of 25 lakh LPD in the span of 24 years.

We are **authorized** by **GEDA (**Gujarat Energy Development Agency, Gandhinagar) as manufacturer /supplier/erector of Solar Thermal Devices (Solar Water Heating Systems) as per guideline and specification of GEDA for any capacity system. We are also registered with **C.S.P.O. (Central Store Purchase Organization)**

On installation of our system you can avail **MNRE capital subsidy** as per newly declared scheme. i.e. **Rs. 6600/**- per **ISI** – **FPC collector** and 80% depreciation in the first year it would be great benefit to your company.

As per your telephonic talk, we are here by enclosing our detailed quotation for **"URMI"** Solar Water Heating System **Cap: 5000, 7000 & 10,000 LPD** Forced Flow Type with technical specification, Scope of supply and cost analysis for your kind consideration.

For more details please write or call us, so we will depute our representative to your office.

We hope that you will find our quotation most competitive and shall thank to send us your valued order at an early date and oblige.

Regards,

- **Harshad Patel**
- **URMI Solar Systems Ltd.**

- 09426010911, 099 78 541 876

For more about us you may visit www.urmisolar.com

USSL/**AGRAWAL**/10-11/383 Date: 15-Mar-11

QUOTATION FOR "URMI' SOLAR WATER HEATING SYSTEM FORCED FLOW TYPE

"URMI" Solar Water Heating System Type: **Forced Flow with ISI Copper-Fin-tubes Collectors & MS:** Insulated Hot Water Storage Tank	**5000 LPD with 34 Collectors**	7000 LPD with **47** Collectors
System basic price	**520,000**	**700,000/-**
Plus: Transportation, Lifting, Installation & Commissioning Charges (Depends on delivery, Building Floor	Actual	Actual
Plus: 5% VAT	26,000/-	35,000/-
Amount payable to "URMI" - A	**546,000/-**	**735,000/-**

QUOTATION FOR 10,000 LPD FORCED FLOW TYPE

"URMI" Solar Water Heating System Type: **Forced Flow with ISI Copper-Fin-tubes Collectors & MS:** Insulated Hot Water Storage Tank	10,000 LPD with **67** Collectors
System basic price	**10,00,000**
Plus: Transportation, Lifting, Installation & Commissioning Charges (Depends on delivery, Building Floor	Actual
Plus: 5% VAT	50,000/-
Amount payable to "URMI" - A	**10,50,000/-**

Above system price comprising of following components				
1.	**Particulaires**	For 5000 LPD	For 7000 LPD	For 10000 LPD
1.	'ISI' **Copper Fin-Tubes** dully **ultrasonic** ting welded Solar Flat Plate Collectors.	34 Nos.	**47 Nos.**	**67 Nos.**
2.	MS & 100mm Insulated Hot Water Storage tank with MS angle Stand	1 No. of 5mm thk	1 No. of 6mm thk	1 No. of 7mm thk
3.	Circulating pump set	1 Set	1 Set	1 Set
4.	Digital Control Panel	1 No.	1 No.	1 No.
5.	Instrumentations :			
	Température Indicator	2 Nos.	2 Nos.	2 Nos.
	Gate Valve	2 Nos.	2 Nos.	2 Nos.

Area required for installation: Shadow free south facing area required for installation of Solar Flat Plate Collector @ 3.5 sq. mtr. Per collector on top of roof/near by where hot water is to be utilized.

USSL/**AGRAWAL**/10-11/383 Date: 15-Mar-11

TERMS & CONDITIONS

PRICE	EX Our Factory.
TAX	5 % VAT in included. Transportation, lifting & installation are not included in above rates. If any other charges applicable at the time of delivery will be charged extra.
PAYMENT	50 % advance with order.
	30 % before dispatch at site
	20 % within week after delivery.
	State Bank of India, Vatva Industrial Estate Branch, GIDC, Vatva, Ahmedabad-382445, Gujarat, India. A/C. No. : 10278778933,(IFS Code: SBIN0001754)
DELIVERY	Within 15 days after receiving your confirm order & advance
GUARANTEE	ONE year against manufacturing defect. We do not guarantee system damage due to nature cause, use of impure water, Glass breakage or Electric components & Scale formation in the system.
ELECTRIC SUPPLY	You will provide necessary electrical supply to the control panel board.
COLD WATER SUPPLY	Constant Cold-water supply to the system on terrace at @ 25 % of system capacity Lt/hr rate on terrace will be provided by your self. Thermosyphon system is installed 10 feet below the source of your cold water supply for getting gravity flow to hot water storage tank.
CIVIL WORK	You will carry out grouting of SWHS as per our instruction.
VALIDITY	20 days from issue of this quotation.
SCALE MASTER	Scale master Mfg. By scale Master Adlam Ltd, Hyderabad of appropriate capacity provided by user at cold water supply inlet of Solar Water Heating System for preventing scale formation in Solar Collectors.
PIPING	As per our terms & Conditions external piping (Your Cold Water tank to solar tank & Solar tank to hot water use point is not covered in above rate. i.e. all piping will be carried out by yourself as per our guideline.
MNRE SUBSIDY	After completion of Installation & Commissioning of system & receiving 100% payment of installed system, we will submit your application to REDA- Jaipur for subsidy process. You have to provide necessary documents along with subsidy application i.e. organization registration certificate, installation & commissioning certificate, your C.A. certificate for S.O.E. (statement Of Expenditure & 100% payment done for the same. REDA officer will visit the site & inspect the installed system than they will submit all documents to MNRE-Delhi. Than after either MNRE or GEDA will sent Cheque of Subsidy to you.

- Harshad Patel
- URMI Solar Systems Ltd.

USSL/**AGRAWAL**/10-11/383 Date: 15-Mar-11

TECHNICAL **SPECIFICATION** FOR "URMI" S.W.H.S.

1.	**"ISI-Solchrome-" Collector**	
1.	Type of Collector	**Copper** - Flat Plate Collector
2.	Collector dimensions	Length: 2030mm ± 10mm Width: 1030mm ± 10mm Thickness: 100mm ± 10mm
4.	Absorber Area	@2 Sq. Mtr.
5.	Absorber Coating Absorptive Emissive Absorber thickness	Solchrome Solar **Nickle Selective coating** 96% ± 2% 12% ± 2% 0.12mm
6.	Collector Box Material **Size**Thickness	Powder Coated Extruded Aluminum, Channel/Angle 100mm x 25mm x 25mm/25mm x 25mm 1.6mm /1.2mm
7.	Collector Back **Copper Risers** Riser: Thickness / O.D.	22 SWG Aluminum Sheet **9 Nos.** 0.56mm / O.D:12.7mm
8.	Copper Header Header Thickness / O.D.	02 Nos. 0.7mm / 25.4mm
9.	Method of **bonding to absorber**	**100 % Continues TIG welding**
10.	Insulation Material: Material Thick. Of Bottom Insulation Thick. Of Side Insulation Density Thermal conductivity	 Rock wool 50mm 25mm 48Kg./M3 0.33W/MK.
11.	Insulation Cover	Aluminum foil
12.	Details of Glazing Material Material Thickness Transmitivity Sealing	 Toughened Glass 4mm 85% U-Type EPDM Rubber, Silicone sealing
13.	Header Inlet/Outlet	Brass flanges
14.	Test Pressure	6Kg./Sq.Cms.
15.	Collector Weight	40 Kgs.
16.	Supporting Structure	M.S structure of 30 X 30 X 3 mm angle dully Epoxy painted
17	Flange gasket	CHAMPION/KLINGER "CAF"
18	Flange Bolts & Nut	SS 304
19	Connection	Brass

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2.00	**Hot Water Storage tank**	
	Capacity	5000 /7000 / 10000 Ltr.
	Size	As per site
	Material	M.S. 5 /6 /7 mm thk + Desends
	Manhole size	450mm Ø
	Inlet & Out let	1 ½ " Flanges
	Testing	Hydraulically 5 Kg/cm2
	Insulation	100mm thk MINWOOL/ROCKWOOL make.
	Cladding	Aluminum sheet 24 SWG
3.00	**Circulating Pump (Between Collectors & Hot Water Tank)**	
	Make	TEXMO
	Capacity	For 5000 LPD :1 HP, 220 V, 50 HZ For 7000 & 10,000 LPD :1.5 HP, 220 V, 50 HZ
	Liquid Temp.	90 ºC
	M.O.C.	C.I Body, Impeller SS 316
	Base	SKID Mounting with serrated rubber pads, Anti-Vibration separation.
4.00	**Control Panel (Differential temp.controller)**	
	Box	0.5mt X 0.5mt. M.S.18SWG, Weather proof
	Type of control	Digital Differential Temp. Controller, 0-20ºC
	Sensor	PT-100 RTD
	Accessories	Main Switch: 2 pole, 10 Amp L & T, Auto/Manual switch:2 pole, 10 Amp L&T Indicating lamp: 2 Nos. L&T Earthling: ⅜' SS 304 bolt & nut with Lugs
5.00	**INSTRUMENTATIONS**	
	Temperature Gauge	Bi- metallic stems ½." BSP
	Steiner	1" C.I. Body, S.S. mess
	Non return Valve	1" ISI make Gun metal
	Air Valve	½" BSP Brass.
	Gate valve	1" ISI make Gun metal
6.00	**PIPING**	
	Size & material	1" NB GI "B" class ISI
	Fittings	ISI make
7.00	**HOT WATER PIPE INSULATION**	
	Material	25mm Glass wool
	Cladding	26 SWG Aluminum
8.00	**Solar Panel Guard**	
	Frame	20mm X 20mm X 3mm M.S Angle
	Irons pigeon Mesh	GI 16 SWG wire mesh of 1" sq.

- Harshad Patel
- URMI Solar Systems Ltd.

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