DETAILED PROJECT REPORT
ON
TECHNOLOGICAL UPGRADATAION WITH HIGH EFFICIENCY ELECTRIC MOTOR (75 kW)
(GUJARAT DAIRY CLUSTER)










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TECHNOLOGICAL UPGRADATAION WITH HIGH EFFICIENCY ELECTRIC MOTOR (75 kW)

GUJARAT DAIRY CLUSTER

BEE, 2010

Detailed Project Report on Technological Upgradataion With High Efficiency Electric Motor (75 kW)

Gujarat Dairy Cluster, Gujarat (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: ***GUJ/DRY/EFF/13***

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Petroleum Conservation Research Association

Ahmedabad

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List of Abbreviation

BEE	Bureau of Energy Efficiency
MoMSME	Ministry of Micro Small and Medium Enterprises
DPR	Detailed Project Report
GHG	Green House Gases
CDM	Clean Development Mechanism
DSCR	Debt Service Coverage Ratio
NPV	Net Present Value
IRR	Internal Rate of Return
ROI	Return on Investment
WHR	Waste Heat Recovery
SCM	Standard Cubic Meter
MW	Mega Watt
SIDBI	Small Industrial Development Bank of India
MT	Million Tonne
DSH	De-super Heater

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 Energy Efficient Motor in refrigeration system, 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)	3.79
2	Expected Electricity Savings	kWh/annum	34522
3	Expected Additional Fuel Consumption	SCM/year	0

S.No	Particular	Unit	Value
4	Monetary benefit	(Rs. in Lakh)/annum	2.02
5	Debit equity ratio	Ratio	3 : 1
6	Simple payback period	Yrs	1.87
7	NPV	(Rs. in Lakh)	5.07
8	IRR	%age	39.83
9	ROI	%age	23.06
10	DSCR	Ratio	2.70
11	Process down time	Days	2

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) Curd
4) Milk Cream
5) Butter / Butter Milk
6) Ghee / Cheese
7) Skimmed Milk Powder
8) 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	☼	☼					

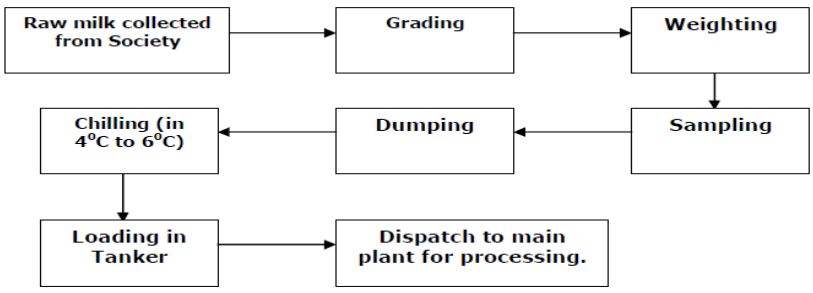
General production process for Dairy cluster

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.

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.

Process Diagram for Typical Milk Chilling Center



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 it's 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℃. This prevents the development of extra bacteria and keeps the milk its freshest.

Cream Extraction & Butter

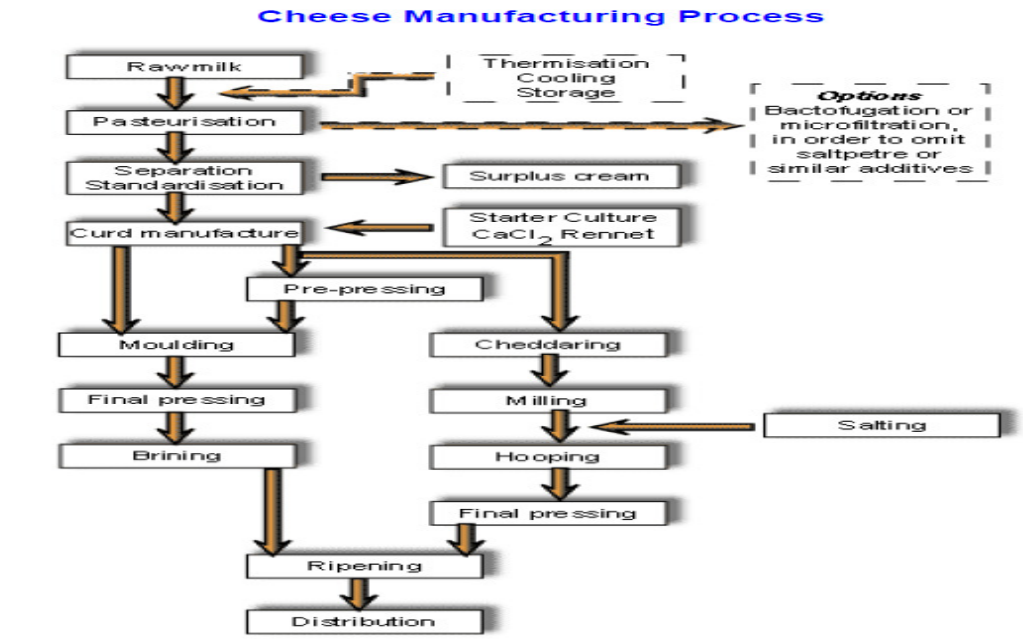
Milk cream is extracted from Milk using centrifuge. The butter making process involves quite a number of stages. The continuous butter maker has become the most common type of equipment used. The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer. 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.

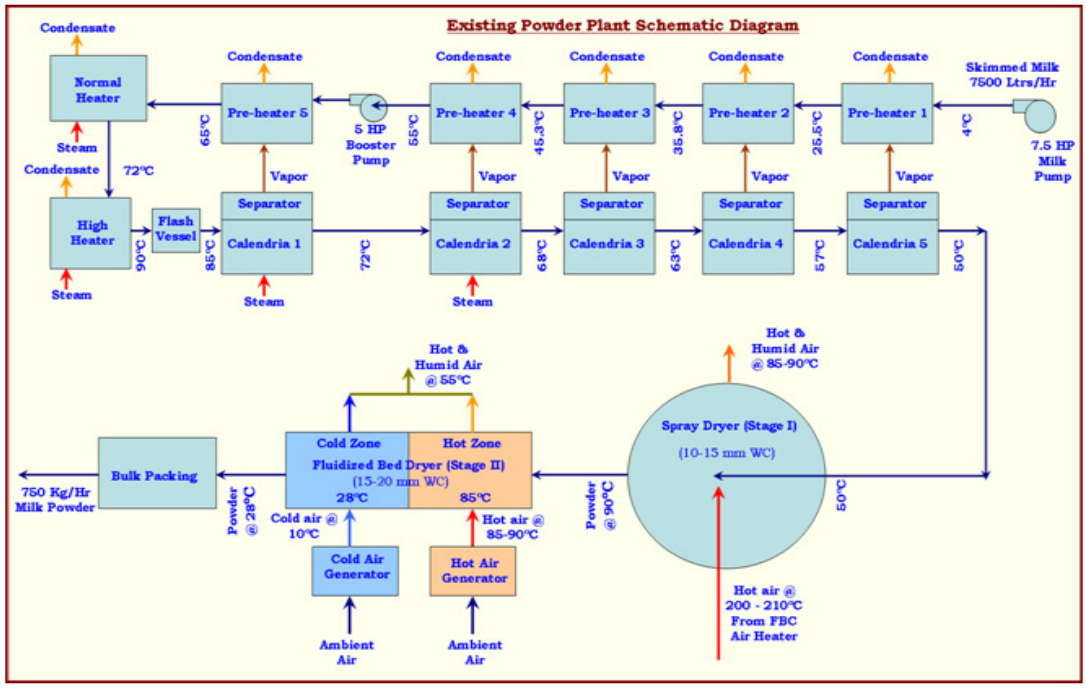
Cheese

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

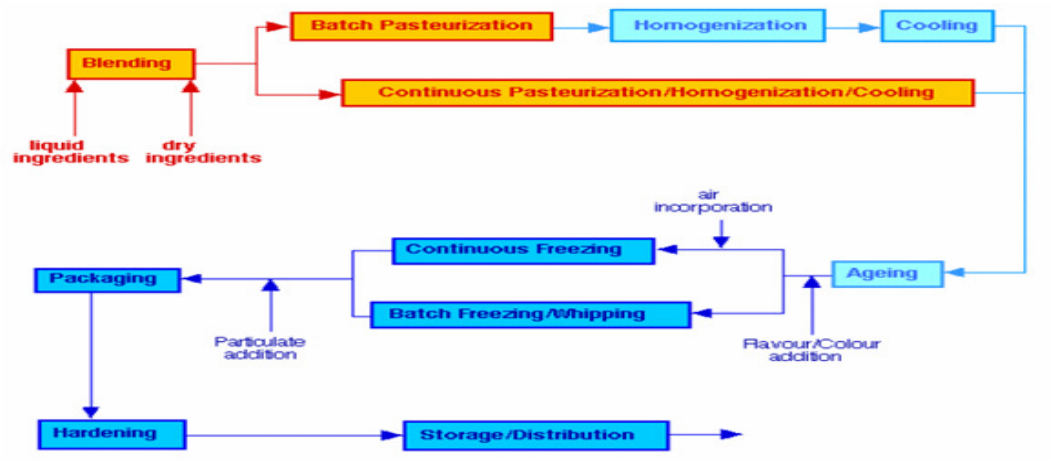
Milk Powder

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





Ice Cream: The Ice cream process can be briefly explained from sketch below.



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 per/year is taken in case of Milk and Milk products solids and semi solids are in their liter equivalent are given in the following Table 1.5 below:

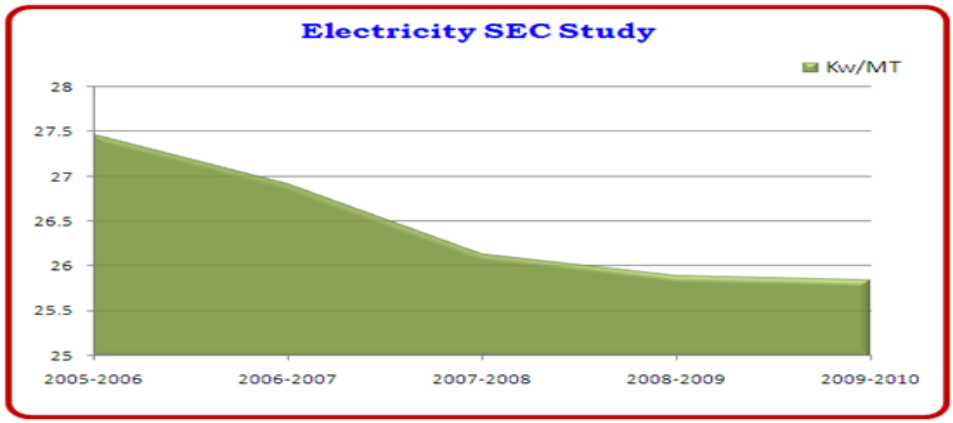
Table 1.5 Average annual production

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

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

Electricity SEC Study in Dairy Cluster over Past Few Years



Thermal Energy SEC Study in Dairy Cluster over Past Few Years

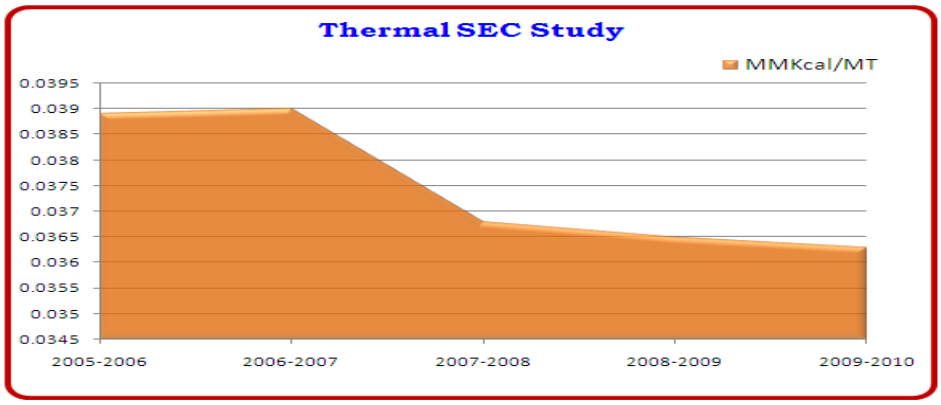


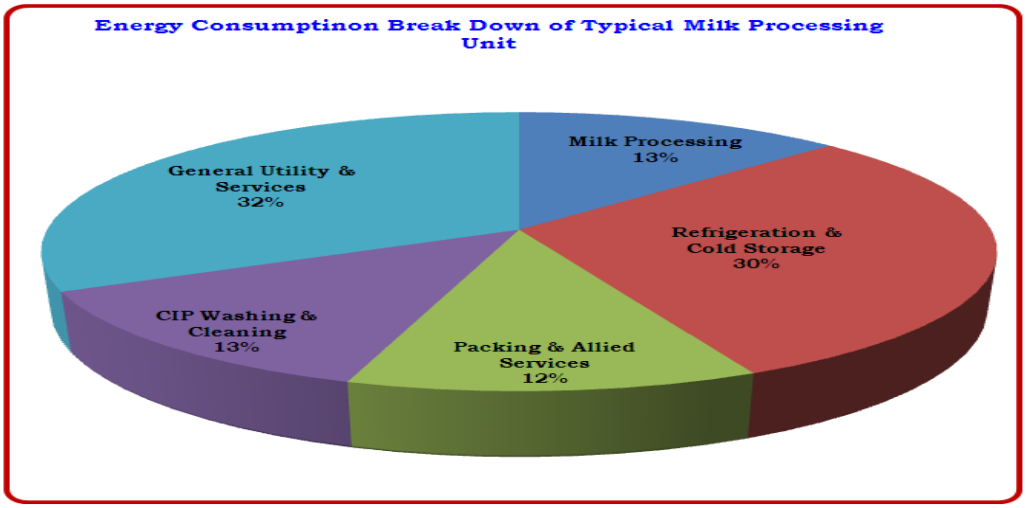
Figure 1.1 SEC Study in Dairy Cluster over Past Few Years

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

In any industry about 70% of electrical energy is consumed by electric motor. In Dairy cluster also about 75% of electrical energy consumption is consumed by electric motor. All the units are employing vapor compression based ammonia cycle for refrigeration requirements. The electric motors are the only driver for vapor compression ammonia cycle. By improving efficiency level of motor by retrofitting with premium efficiency energy efficient electric motor (EFF1 level or higher), the energy consumption by vapor compression ammonia system can be reduced at least by 5%.

SN	Details	Specification
1)	Capacity	75 kW
2)	RPM	1440 RPM
3)	Frame Size	280 S
4)	Type	Foot mounted, Squirrel cage type
5)	Whether Re-wounded	Re-wounde
6)	Other Specifications	415 Volts ± 10%; 3 Phase, 50 HZ ± 5%
7)	Efficiency Level	87.5%

Energy charges

Table 1.7 Energy charges

S. No.	Contract Demand, kVA	Energy Charges, Rs/kW
1	Upto 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. 5.86 per kWh in considered case.

1.3.2 Role in process

The electric motor has to play very important role in all industries including dairy industry as major electricity is consumed by electric motor. The existing most of the Milk chilling center / Dairies are not provided with Super premium energy efficient electric motors. Most of the motors are more than 2-3 times rewound with efficiency level EFF2 or lower level. All the units are employing vapor compression based ammonia cycle for refrigeration requirements. The electric motors are the only driver for vapor compression ammonia cycle. By improving efficiency level of motor by retrofitting with premium efficiency energy efficient electric motor (EFF1 level or higher), the energy consumption by vapor compression ammonia system can be reduced at least by 5%.

1.4 Baseline establishment for existing technology

In a typical dairy reciprocating compressor for ammonia vapor compression cycle are provided.

SN	Ammonia Compressor Particulars	Model	Motor Rated kW	Measured kW	Rated TR
1)	Chilled Water Section Comp. No.1	KC-4	75	53.5	60
2]	Chilled Water Section Comp. No.2	Sabroe (KC4)	75	57.9	60
3)	Cold Storage Section Comp No. 1	KC-4	75	56.8	60
Total			225	168.2	180

The existing consumption for EFF2 or lower efficiency electric motor is 57.9 kW i.e.122357 kWh/ Annum

1.4.1 Design and operating parameters

The existing most of the Milk chilling center / Dairies are not provided with Super premium energy efficient electric motors. Most of the motors are more than 2-3 times rewound with efficiency level EFF2 or lower level.

The specifications of existing electric motor is

SN	Details	Specification
1)	Capacity	75 kW
2)	RPM	1440 RPM
3)	Frame Size	280 S
4)	Type	Foot mounted, Squirrel cage type
5)	Whether Re-wounded	Re-wounde
6)	Other Specifications	415 Volts ± 10%; 3 Phase, 50 HZ ± 5%
7)	Efficiency Level	87.5%

1.4.2 Operating efficiency analysis (Existing Loss Study)

Load profile (kW Vs Time) of existing ammonia compressor using data logger carried for few ammonia compressors. It was observed that the ammonia compressors are subjected to frequent part load values depending on the demand for chilling.

Stator and Rotor I^2R Losses

These losses are major losses and typically account for 55% to 60% of the total losses. I^2R losses are heating losses resulting from current passing through stator and rotor conductors. I^2R losses are the function of a conductor resistance, the square of current. Resistance of conductor is a function of conductor material, length and cross sectional area. The suitable selection of copper conductor size will reduce the resistance. Reducing the motor current is most readily accomplished by decreasing the magnetizing component of current. This involves lowering the operating flux density and possible shortening of air gap. Rotor I^2R losses are a function of the rotor conductors (usually aluminium) and the rotor slip. Utilization of copper conductors will reduce the winding resistance. Motor operation closer to synchronous speed will also reduce rotor I^2R losses.

Core Losses

Core losses are those found in the stator-rotor magnetic steel and are due to hysterisis effect and eddy current effect during 50 Hz magnetization of the core material. These losses are independent of load and account for 20 – 25 % of the total losses.

The hysteresis losses which are a function of flux density, are be reduced by utilizing low-loss grade of silicon steel laminations. The reduction of flux density is achieved by suitable increase in the core length of stator and rotor. Eddy current losses are generated by circulating current within the core steel laminations. These are reduced by using thinner laminations.

Friction and Windage Losses

Friction and Windage losses results from bearing friction, Windage and circulating air through the motor and account for 8 – 12 % of total losses. These losses are independent of load. The reduction in heat generated by stator and rotor losses permit the use of smaller fan. The Windage losses also reduce with the diameter of fan leading to reduction in Windage losses.

Stray Load-Losses

These losses vary according to square of the load current and are caused by leakage flux induced by load currents in the laminations and account for 4 to 5 % of total losses. These losses are reduced by careful selection of slot numbers, tooth/slot geometry and air gap.

Energy efficient motors cover a wide range of ratings and the full load efficiencies are higher by 3 to 7 %. The mounting dimensions are also maintained as per IS1231 to enable easy replacement.

As a result of the modifications to improve performance, the costs of energy-efficient motors are higher than those of standard motors. The higher cost will often be paid back rapidly in saved operating costs, particularly in new applications or end-of-life motor replacements. In cases where existing motors have not reached the end of their useful life, the economics will be less clearly positive.

Losses	2- Pole average	4- pole average	Factors affecting losses
Core losses	19%	21%	Electrical steel, air gap, saturation
Friction & Windage losses	25%	10%	Fan efficiency, Lubrication, bearing
Stator Copper losses	26%	34%	Conductor area, mean length of turn, heat dissipation
Rotor Copper losses	19%	21%	Bar and end ring area and material
Stray Load losses	11%	14%	Manufacturing process, slot design, air gap

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.

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, they agreed with most of the identified energy saving measures and technologies.

There appears to be no technological barrier. 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 energy efficient electric motor. 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 up gradation. 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 units like ammonia compressors, hot air generators for spray dryers etc , are generally taken care by the equipment suppliers itself as they station one of their experienced technical representative 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.

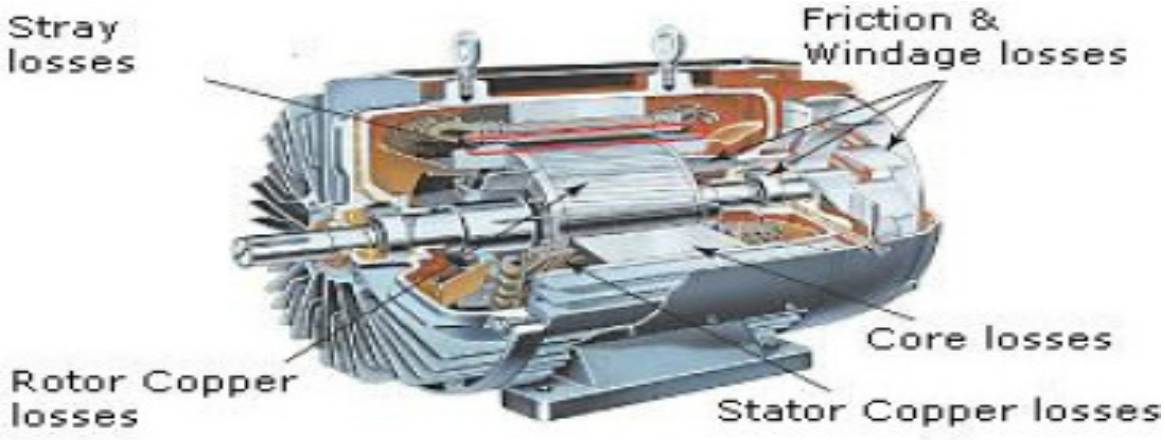
1.5.4 Other barrier (If any)

No other barrier is seen. It appears that apart from high initial cost of energy efficient electric motor, there is no other barrier.

2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

As explained earlier, almost 70% of electricity in industry is consumed by electric motor, any slightest improvement in efficiency of motor results in considerable saving of energy. Pl refer the following graph for various efficiency level of electric motor.



Motor losses

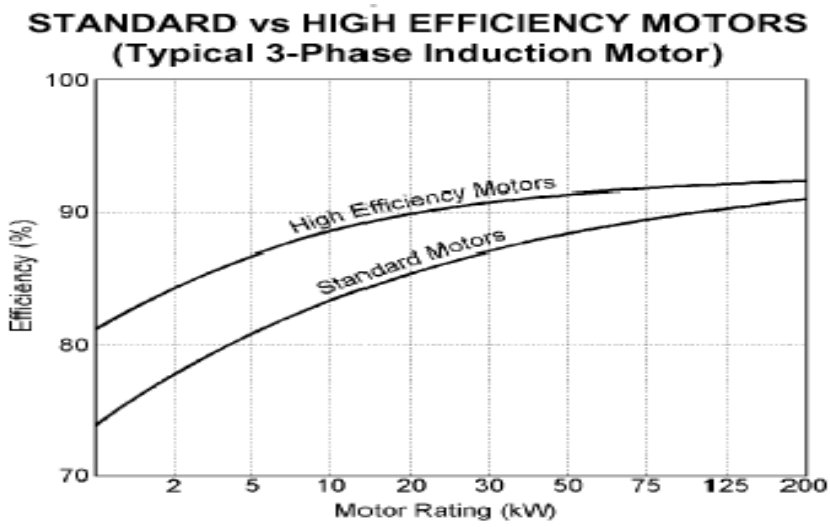
The energy efficient electric motors are more costly than the conventional standard efficiency electric motor (efficiency level EFF2 or lower), but if we consider the entire life cycle cost (LCC) of electric motor then the results shows different facts.

Energy-efficient motors (EEM) are the ones in which, design improvements are incorporated specifically to increase operating efficiency over motors of standard design. Design improvements focus on reducing intrinsic motor losses. Improvements include the use of lower-loss silicon steel, a longer core (to increase active material), thicker wires (to reduce resistance), thinner laminations, smaller air gap between stator and rotor, copper instead of aluminum bars in the rotor, superior bearings and a smaller fan, etc.

Importance of Running Cost of Motor Driven Equipment

Motor rating (kW)	7.5	7.5	37	37
Efficiency, p.u	0.86	0.88	0.92	0.93
Power input (kW)	8.72	8.52	40.22	39.78
Running hours/year	6000	6000	6000	6000
Energy input (kWh/year)	52320	51120	241320	238680
Running cost @ Rs. 5 per kWh	2,61,600	2,55,600	12,06,600	11,93,400
Running cost for 10 years (Rs.)	2,616,000	2,556,000	12,066,000	11,934,000
First cost (Rs.)	15000	18000	80000	96000
First cost as % of running cost for 10 years	0.6	0.7	0.8	0.9

Energy-efficient motors now available in India operate with efficiencies that are typically 3 to 4 percentage points higher than standard motors. In keeping with the stipulations of the BIS, energy-efficient motors are designed to operate without loss in efficiency at loads between 75 % and 100 % of rated capacity. This may result in major benefits in varying load applications. The power factor is about the same or may be higher than for standard motors. Furthermore, energy-efficient motors have lower operating temperatures and noise levels, greater ability to accelerate higher-inertia loads, and are less affected by supply voltage fluctuations.



Standrd vs High Efficiency Motors

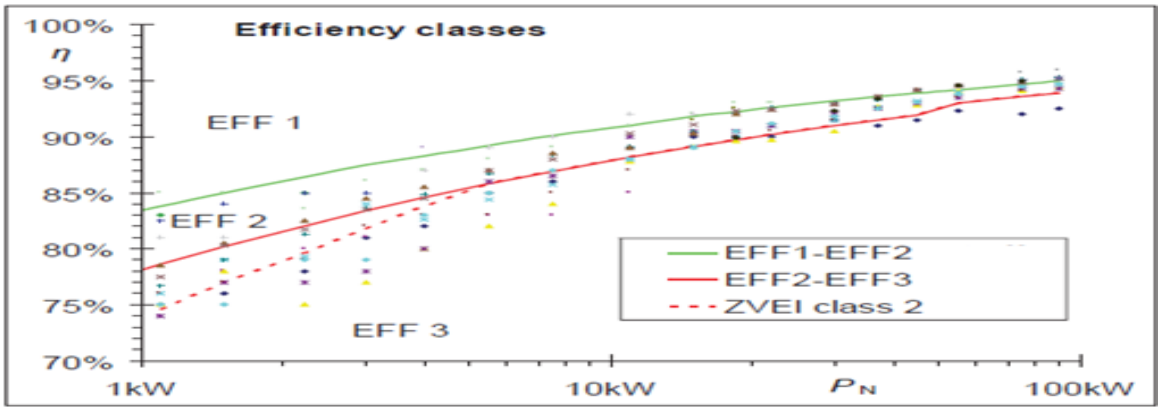
2.1.1 Detailed of proposed equipment

Electrical motor (industrial, commercial, domestic and agriculture) alone consumes about 70% of country's total generated power (83000MW). If, by effective energy conservation it is possible to improve the efficiency of drive system by 0.5%, electrical power amounted to 83000 x 0.7 X 0.005 = 290 MW can be saved or alternately generated every day

As mentioned earlier, 70% of electricity consumed by any industry is consumed by electric motor, slightest improvement in efficiency of electric motor impacts energy saving on positive side. The existing motors are of EFF2 or lower efficiency & also many are rewound for many times. The field study of electric motors & detailed energy audit report indicates the scope of energy saving in electric motors.

Motor efficiency is the ratio of mechanical power output to the electrical power input, usually expressed as a percentage. Considerable variation exists between the performance of standard and energy-efficiency improved design, materials, and manufacturing techniques enable energy-efficient motors to accomplish more work per unit of electricity consumed. Energy-efficient motors offer other benefits. Because they are constructed with improved manufacturing techniques and superior

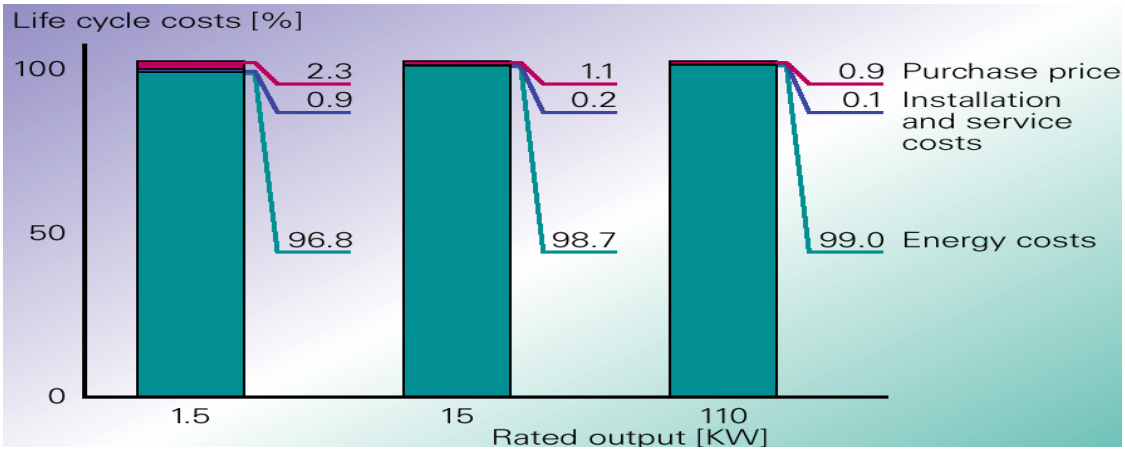
materials, energy-efficient motors usually have higher service factors, longer insulation and bearing lives, lower waste heat output, and less vibration, all of which increase reliability. Most motor manufacturers offer longer warranties for their most efficient models.



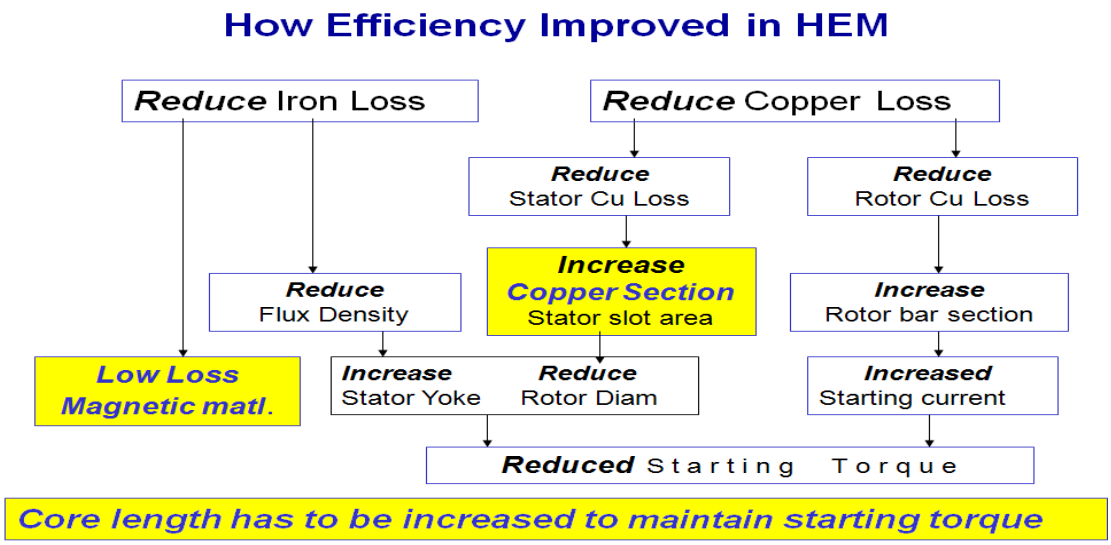
From above graph it is clear that if the motor upgraded from EFF3 or EFF2 will result in energy saving. But due to higher initial cost, industry prefers the standard efficiency electric motor. Please refer following graphs indicating the importance of LCC (Life cycle Cost) concept. The purchase price of electric motor is of the order of 0.9 to 2.3% of total LCC of electric motor.

It can be concluded that by proper awareness creation, propagation of LCC concept, providing financial arrangement for purchase of higher initial cost Energy Efficient electric motor, will help to implement the measure of Energy efficient electric motor.

It has been observed that penetration of energy efficient electric motor in the various industries including dairies from cluster will result in continuous energy saving over the life cycle of electric motor.



Please refer the following schematic diagram explaining how efficiency is improved in Energy efficient electric motor.



A summary of energy efficiency improvements in EEMs

Energy Efficient Motors	
Power Loss Area	**Efficiency Improvement**
1. Iron	Use of thinner gauge, lower loss core steel reduces eddy current losses. Longer core adds more steel to the design, which reduces losses due to lower operating flux densities.
2. Stator I^2R	Use of more copper and larger conductors increases cross sectional area of stator windings. This lowers resistance (R) of the windings and reduces losses due to current flow (I).
3. Rotor I^2R	Use of larger rotor conductor bars increases size of cross section, lowering conductor resistance (R) and losses due to current flow (I).
4. Friction & Windage	Use of low loss fan design reduces losses due to air movement.
5. Stray Load Loss	Use of optimized design and strict quality control procedures minimizes stray load losses.

2.1.2 Equipment/technology specification

DESCRIPTION

Squirrel Cage type, 3 phase induction motors are provided with belt pulley drive arrangement.

Technical Specification considered –

SN	Details	Specification
1)	Capacity	75 kW
2)	RPM	1440 RPM
3)	Frame Size	280 S
4)	Type	Foot mounted, Squirrel cage type
5)	Whether Re-wounded	New Motor
6)	Other Specifications	415 Volts ± 10%; 3 Phase, 50 HZ ± 5%
7)	Efficiency Level	95.4%

2.1.3 Integration with existing equipment

The energy conservation proposal is of the retrofit type, thus old lower efficiency electric motor have to be replaced by new energy efficient electric motor. The new motor can be fully integrated with existing system without any problem as it does not need change in drive arrangement such as starters, does not need change in foundation as same frame size motor being used. No change in cable, belts or pulley is required. The new motor can be fully integrated with existing system without any problem.

2.1.4 Superiority over existing system

The proposed electric motors are more energy efficient that existing one and are technologically superior. Use of this technology reduces the overall plant energy cost. It also reduces the dependency for electricity on the state electricity grid. The proposed measure bears better technology than the existing one results both energy saving & 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

4-5 Hours are required to change the existing normal or standard efficiency electric motor with energy efficient electric motor.

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. Majority of the dairies & Milk chilling centers (18 numbers in cluster) are suitable for implementation of this measure.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 TECHNICAL BENEFIT

3.1.1 Fuel saving

No direct fuel saving by this measure. The electricity saved may indirectly save the fuel.

3.1.2 Electricity saving

It is estimated that this system will save 34522 kWh per annum (2.97KLOE per Annum) for the unit.

3.1.3 Improvement in product quality

The measure does 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 on an average 34522 kWh/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)

Energy and monetary benefit			
1)	Actual KWh Consumption of Existing Motor	kWh/Hr	57.9
2)	Expected Saving by replacing electric motors having efficiency less than that of EFF1 level with EE motor having Efficiency level of at least EFF1 or higher level	kWh/Hr	4.79
3)	Cost of Electricity	Rs./ kWh	5.86
4)	Expected Saving in kWh/Annum	kWh/Annum	34522
5)	Expected Saving per Annum (Considering 360 Working Days)	Rs./Annum	202296
6)	Expected Investment Needed for replacing existing motor with EE motor.	Rs.	379000
7]	Simple Payback	Yrs	1.87
		Months	22
8)	KLOE Saving per Annum	KLOE/Annum	2.97

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

3.3 SOCIAL BENEFITS

3.3.1 Improvement in working environment

Use of energy efficient electric motor technology in Dairy Industry reduces the energy consumption. This improves efficiency of refrigeration system 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. This project results in reduction of peak demand and uses off-peak electricity. Hence it will help in reducing CO_2 emission as good as 18 tonnes (17.748 tonnes) annually.

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 Energy efficient motor with installation, erection, commissioning, standard mountings & accessories including taxes is Rs.3.79 Lacs per 75 kW Energy efficient electric Motor.

4.1.2 Erection, commissioning and other misc. cost

Total erection and commissioning cost is Rs. 0.02 lakh. 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	Rs. (in Lacs)	3.7
2	Detail Engineering, Design & related expenses	Rs. (in Lacs)	0.01
3	Erection & Commissioning cost	Rs. (in Lacs)	0.02
4	Cost of civil work	Rs. (in Lacs)	0.02
5	Custom Clearance & Transportation Charges	Rs. (in Lacs)	0
6	Import duty	Rs. (in Lacs)	0
7	Other charges (Including Contingency 10%)	Rs. (in Lacs)	0.04
	Total cost	Rs. (in Lacs)	3.79

4.2 ARRANGEMENTS OF FUNDS

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost i.e. Rs. 0.95 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. 2.84 Lakh, with repayment of 7 years considered for the estimation purpose.

4.2.3 Terms & 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 7 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 10 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. 2.02 lacs.

- 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. 1.50 lakh in the first year's operation and Rs. 9.72 lakh at the end of tenth year's.

4.3.2 Simple payback period

The estimated payback period is about 1.87 years or about 22 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be 5.07 lakh.

4.3.4 Internal rate of return (IRR)

The after tax IRR of the project works out to be 39.83%. 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 23.06%.

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	39.83%	5.07	23.06	2.70

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 energy savings by 5%)
- Pessimistic scenario (Decrease in energy 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	39.83%	5.07	23.06	2.70
2	5% Increase in Fuel Saving	42.25%	5.51	23.18	2.84
3	5% Decrease in Fuel Saving	37.41%	4.63	22.93	2.57

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.

Table 4.4 Procurement and implementation schedule

SN	Activities	Weeks			
		1	-	11	12
1	Order Placement				
2	Delivery				
3	Foundation & civil work				
4	Erection & commissioning				
5	Cabling & electrical panel fitting				
6	Testing and trial				
7	On site operator training				

Note: - The word foundation & civil work is alternatively used for installation & erection (that includes minor/major civil work, grouting required for saddle plates, foundation modification etc).

For electric motors as in many cases are very old motors are to be replaced by new energy efficient electric motor. Though frame size is same, it is observed that practically the saddle holes of new EE motor foot mounted electric motor may vary with old motor (We expect such modification in most of the cases). In such cases, modification in civil constructed foundation may require. Also it is now standard practice to introduce threaded tensioning arrangement for electric motor for maintaining proper belt tension. Considering these aspect we have considered the foundation & civil work.

Annexure

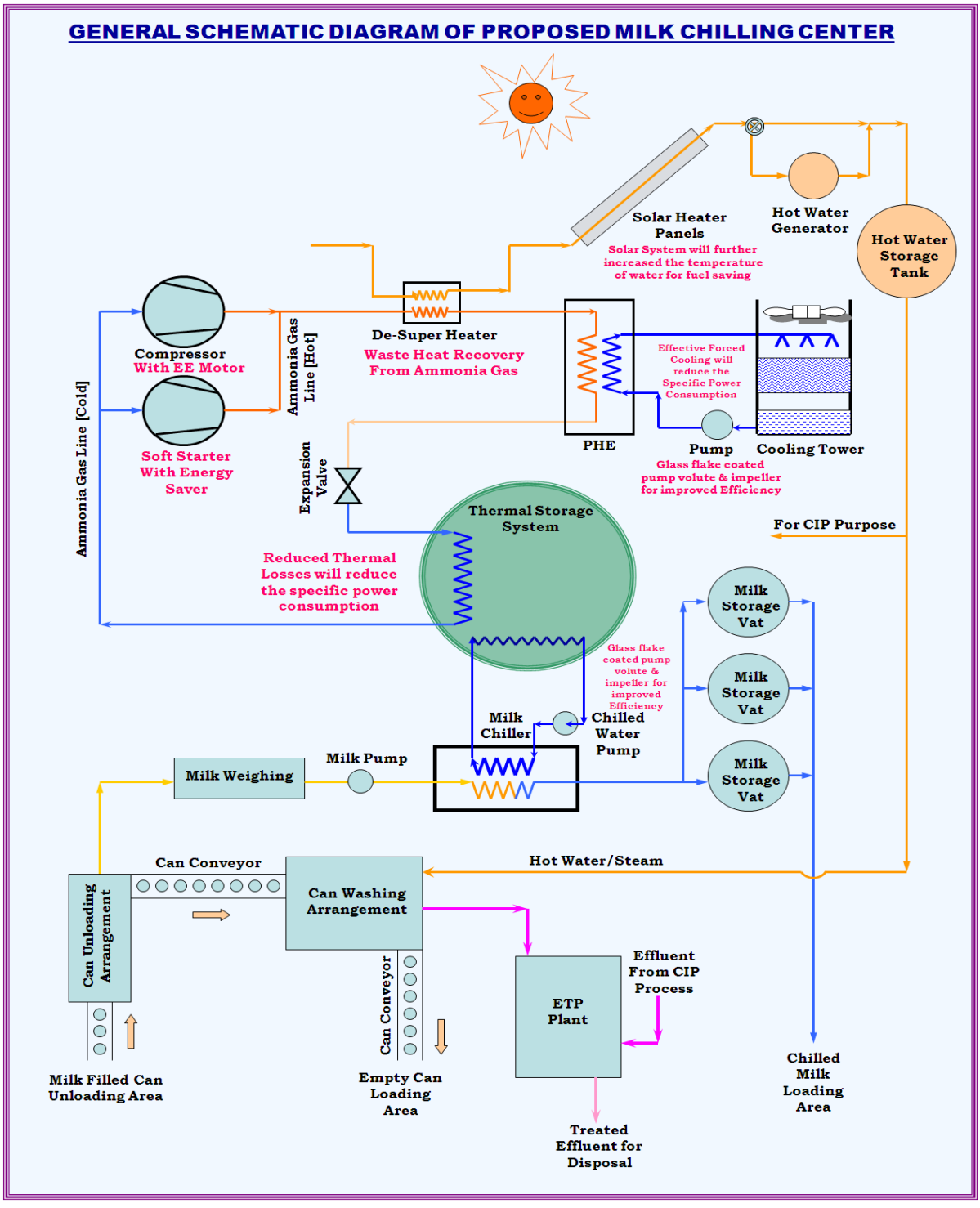
Annexure -1: Energy audit data used for baseline establishment

Considering a typical case of dairy under cluster. The details of consumption of compressor is as given below-

SN	Ammonia Compressor Particulars	Model	Motor Rated kW	Measured kW	Rated TR
1)	Chilled Water Section Comp. No.1	KC-4	75	53.5	60
2]	Chilled Water Section Comp. No.2	Sabroe (KC4)	75	57.9	60
3)	Cold Storage Section Comp No. 1	KC-4	75	56.8	60
	Total		225	168.2	180

The existing consumption for 75 kW EFF2 or lower efficiency electric motor is 57.9 kW i.e.122357 kW/Annum.

Annexure -2: Process flow diagram after project implementation



The process flow will not change. The only change will be the ammonia compressor will be provided with Energy Efficient Electric Mot.

Annexure -3: Detailed technology assessment report

"Electric motor having efficiency less than EFF1 level of efficiency, old many time rewound electric motors to be replaced by electric motors of at least EFF1 or higher level of efficiency. The reciprocating chiller compressor motors, condenser water pump motors, chiller pump motors, motors for can washing machine etc with efficiency less than EFF1 level can be replaced by EFF1 or higher level of electric motors. It is strongly recommended to adopt standard rewinding practices along with standard rewinding material to maintain the efficiency level of electric motors.

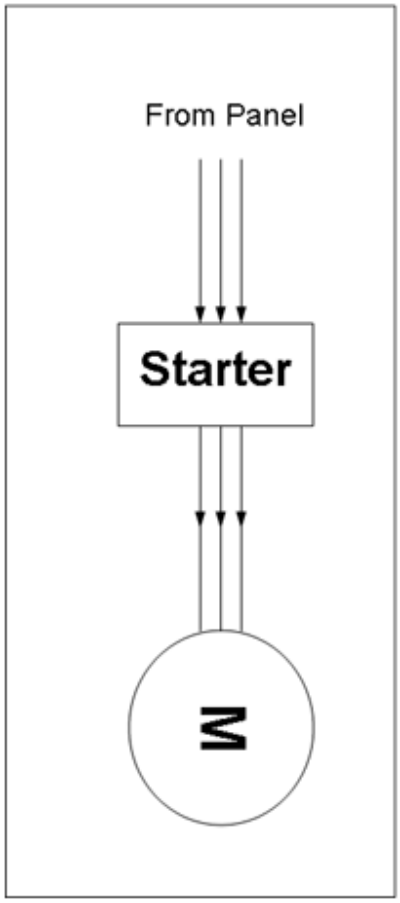
The existing older motors are of efficiency level of EFF2 or lower efficiency. Thus by replacing these motors with energy efficient motors of EFF1 or higher level can result in energy saving upto 5% of electricity consumption by major Non EFF1 electric motors.

The details of cost benefit analysis are as given below –

Cost Benefit Analysis			
1	Capacity of Existing VC Cycle Compressor (Working or on-load)	kW	75
2	Working Hours for Compressor/Day	Hrs/Day	20
3	Actual electricity Consumption of Compressor (At 87.5% present motor efficiency)	kWh/Hr	57.9
4	Actual electricity Consumption of Compressor (At 95.4% Energy Efficient Motor Efficiency)		53.11
5	Electricity saving	kWh/Hr	4.79
6	Cost of Electricity	Rs./kWh	5.86
7	Expected Saving in kWh/Annum	kWh/Annum	34522
8	Expected Saving per Annum (Considering 360 Working Days)	Rs./Annum	202296
9	Expected Investment Needed for replacing existing motor with EE motor.	Rs.	379000.00
10	Simple Payback	Yrs	1.87
		Months	22
11	KLOE Saving per Annum	KLOE/Annum	2.97

Annexure -4 Drawings for proposed electrical & civil works

No additional civil work is required, only minor readjustment of foundation will be required. No change in electrical circuit as the change is of the retrofit in nature. No other changes required.



Annexure -5: Detailed financial analysis

Name of the Technology	*Energy Efficient Electric Motor*		
Rated Capacity	*75 kW*		
Details	*Unit*	*Value*	*Basis*
Installed Capacity	kW	75	
No of working days	Days	360	
No of Operating Hrs. per day	Hrs.	20	
Proposed Investment			
Plant & Machinery	Rs. (in lakh)	3.71	
Civil Work		0.02	
Erection & Commissioning	Rs. (in lakh)	0.02	
Investment without IDC	Rs. (in lakh)	3.75	
Misc. Cost	Rs. (in lakh)	0.04	
Total Investment	Rs. (in lakh)	3.79	
Financing pattern			
Own Funds (Equity)	Rs. (in lakh)	0.95	Feasibility Study
Loan Funds (Term Loan)	Rs. (in lakh)	2.84	Feasibility Study
Loan Tenure	Years	7.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	90.00	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			
Electricity Saving	kWh/Year	20880	
Cost of electricity	Rs./kWh	5.86	
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	2.84	0.12	2.72	0.33
2	2.72	0.24	2.48	0.26
3	2.48	0.28	2.20	0.24
4	2.20	0.32	1.88	0.21
5	1.88	0.48	1.40	0.17
6	1.40	0.52	0.88	0.12
7	0.88	0.60	0.28	0.06
8	0.28	0.28	0.00	0.01
		2.84		

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

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	3.79	0.76
Depreciation	3.03	0.61
WDV	0.76	0.15

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Fuel savings	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
Total Revenue (A)	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
Expenses										
O & M Expenses	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12
Total Expenses (B)	0.08	0.08	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12
PBDIT (A)-(B)	1.95	1.94	1.94	1.94	1.93	1.93	1.92	1.92	1.91	1.91
Interest	0.33	0.26	0.24	0.21	0.17	0.12	0.06	0.01	0.00	0.00
PBDT	1.62	1.68	1.70	1.73	1.76	1.81	1.86	1.91	1.91	1.91
Depreciation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
PBT	1.42	1.48	1.50	1.53	1.56	1.61	1.66	1.71	1.71	1.71
Income tax	0.00	0.37	0.58	0.59	0.60	0.61	0.63	0.65	0.65	0.65
Profit after tax (PAT)	1.42	1.12	0.92	0.94	0.96	0.99	1.03	1.06	1.06	1.06

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
rofit before tax	1.42	1.48	1.50	1.53	1.56	1.61	1.66	1.71	1.71	1.71
Add: Book depreciation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Less: WDV depreciation	3.03	0.61	-	-	-	-	-	-	-	-
Taxable profit	(1.41)	1.08	1.70	1.73	1.76	1.81	1.86	1.91	1.91	1.91
Income Tax	-	0.37	0.58	0.59	0.60	0.61	0.63	0.65	0.65	0.65

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Share Capital (D)	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Reserves & Surplus (E)	1.42	2.53	3.46	4.40	5.36	6.35	7.38	8.44	9.50	10.56
Term Loans (F)	2.72	2.48	2.20	1.88	1.40	0.88	0.28	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	5.09	5.96	6.61	7.23	7.71	8.18	8.61	9.39	10.45	11.51

Assets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Gross Fixed Assets	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79
Less Accm. Depreciation	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
Net Fixed Assets	3.59	3.39	3.19	2.99	2.79	2.59	2.39	2.19	1.99	1.79
Cash & Bank Balance	1.50	2.57	3.42	4.24	4.92	5.60	6.22	7.20	8.46	9.72
TOTAL ASSETS	5.09	5.96	6.61	7.23	7.71	8.18	8.61	9.39	10.45	11.51
Net Worth	2.36	3.48	4.40	5.34	6.31	7.30	8.33	9.39	10.45	11.51
Debt Equity Ratio	2.87	2.62	2.32	1.99	1.48	0.93	0.30	0.00	0.00	0.00

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

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Sources											
Share Capital	0.95	-	-	-	-	-	-	-	-	-	-
Term Loan	2.84										
Profit After tax		1.42	1.12	0.92	0.94	0.96	0.99	1.03	1.06	1.06	1.06
Depreciation		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total Sources	3.79	1.62	1.32	1.12	1.14	1.16	1.19	1.23	1.26	1.26	1.26
Application											
Capital Expenditure	3.79										
Repayment Of Loan	-	0.12	0.24	0.28	0.32	0.48	0.52	0.60	0.28	0.00	0.00
Total Application	3.79	0.12	0.24	0.28	0.32	0.48	0.52	0.60	0.28	0.00	0.00
Net Surplus	-	1.50	1.08	0.84	0.82	0.68	0.67	0.63	0.98	1.26	1.26
Add: Opening Balance	-	-	1.50	2.57	3.42	4.24	4.92	5.60	6.22	7.20	8.46
Closing Balance	-	1.50	2.57	3.42	4.24	4.92	5.60	6.22	7.20	8.46	9.72

IRR ***Rs. (in lakh)***

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Profit after Tax		1.42	1.12	0.92	0.94	0.96	0.99	1.03	1.06	1.06	1.06
Depreciation		0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Interest on Term Loan		0.33	0.26	0.24	0.21	0.17	0.12	0.06	0.01	-	-
Cash outflow	(3.79)	-	-	-	-	-	-	-	-	-	-
Net Cash flow	(3.79)	1.95	1.58	1.36	1.35	1.33	1.31	1.29	1.27	1.26	1.26
IRR	39.83%										

NPV	5.07

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***
Variable Expenses										
Oper. & Maintenance Exp (75%)	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.09
Sub Total*(G)*	0.06	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.08	0.09
Fixed Expenses										
Oper. & Maintenance Exp (25%)	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Interest on Term Loan	0.33	0.26	0.24	0.21	0.17	0.12	0.06	0.01	0.00	0.00
Depreciation *(H)*	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Sub Total (I)	0.55	0.48	0.46	0.43	0.39	0.34	0.29	0.24	0.23	0.23
Sales (J)	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
Contribution (K)	1.97	1.96	1.96	1.96	1.95	1.95	1.95	1.94	1.94	1.93
Break Even Point (L= G/I)	27.93%	24.52%	23.37%	21.99%	19.96%	17.55%	14.71%	12.12%	11.76%	11.86%
Cash Break Even {(I)-(H)}	17.75%	14.32%	13.16%	11.77%	9.71%	7.29%	4.43%	1.82%	1.44%	1.52%
Break Even Sales (J)*(L)	0.56	0.50	0.47	0.44	0.40	0.35	0.30	0.25	0.24	0.24

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Total*
Net Profit Before Taxes	1.42	1.48	1.50	1.53	1.56	1.61	1.66	1.71	1.71	1.71	15.88
Net Worth	2.36	3.48	4.40	5.34	6.31	7.30	8.33	9.39	10.45	11.51	68.88
											23.06%

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*Total*
Cash Inflow											
Profit after Tax	1.42	1.12	0.92	0.94	0.96	0.99	1.03	1.06	1.06	1.06	8.44
Depreciation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	1.60
Interest on Term Loan	0.33	0.26	0.24	0.21	0.17	0.12	0.06	0.01	0.00	0.00	1.39
Total (M)	1.95	1.58	1.36	1.35	1.33	1.31	1.29	1.27	1.26	1.26	11.43

DEBT

Interest on Term Loan	0.33	0.26	0.24	0.21	0.17	0.12	0.06	0.01	0.00	0.00	1.39
Repayment of Term Loan	0.12	0.24	0.28	0.32	0.48	0.52	0.60	0.28	0.00	0.00	2.84
Total (N)	0.45	0.50	0.52	0.53	0.65	0.64	0.66	0.29	0.00	0.00	4.23
	4.33	3.15	2.63	2.55	2.06	2.06	1.95	4.39	0.00	0.00	2.70
Average DSCR (M/N)	2.70										

Annexure:-6 Procurement and implementation schedule

Day wise break up of implementation Schedule

SN	Activities	Days			
		1	2	3	4
1	Foundation & civil work				
2	Erection & commissioning				
3	Cabling & electrical panel fitting				
4	Testing and trial				
5	On site operator training				

Note: - The word foundation & civil work is alternatively used for installation & erection (that includes minor/major civil work, grouting required for saddle plates, foundation modification etc).

For electric motors as in many cases are very old motors are to be replaced by new energy efficient electric motor. Though frame size is same, it is observed that practically the saddle holes of new EE motor foot mounted electric motor may vary with old motor (We expect such modification in most of the cases). In such cases, modification in civil constructed foundation may require. Also it is now standard practice to introduce threaded tensioning arrangement for electric motor for maintaining proper belt tension. Considering these aspect we have considered the foundation & civil work.

Annexure -7: Details of technology service providers

S.No.	Name of Service Provider	Address	Contact Person and No.
1	Pima Controls Pvt. Ltd.	4A, New York Corner, Bodakdev, Ahmedabad - 380015. INDIA.	Mr. Madhukar Parikh Phone: +91-79-40210400 Fax: +91-79-40210410
2	Baldor Electric India Pvt Ltd	19,Commerce Avanue, Mahaganesh Colony Paud Road, Kothrud PUNE 411038 TEL-02025452717/18/19F	Mr.Bhalchandra Bansod - 09766342489 www.baldor.com
3	Bharat Bijlee Limited	Thane-Belapur Road Navi Mumbai 400708	Ph. No.022-27637200

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

An ISO 9001:2000 Certified Company

BE / Q-179 R1 / NGP DATE: 15-03-2011

TO,

PETROLEUM CONSERVATION RESEARCH ASSOCIATION
AHMEDABAD

Dear Sir,

SUB.: YOUR REQUIREMENT OF BALDOR MAKE 75 KW SUPER E MOTOR.

REF.: BY E-MAIL, DATED: 15-03-2011.

We acknowledge with thank receipt of your email, please find below our revised offer for Baldor make 75 KW AC Motor.

We are pleased to inform you that we are the ***Authorized Distributor*** of Baldor Electric for the state of Gujarat. Baldor Electric is a leading Company in the USA and Reliance Electric is part of the Baldor Group manufacturing globally at 28 locations.

Baldor Electric range of products are;

1) Electric Motors from 0.5 HP to 15000 HP ratings for all types of Industrial Application and Environment.

2) DODGE make Mechanical Power Transmission products like Bearings, Gearing, PT Components etc.

3) Baldor offers not only the Standard Efficiency Motors (EFF2) and High Efficiency Motors (EFF1) but is only the company in India to offer you Premium Efficiency Motors manufactured in US with a warranty of two years in India and providing a payback period of roughly one and a half years depending on Applications.

Based on the Motor ratings given by you, we are pleased to submit herewith our quotation for Baldor Motors as per the following for your kind consideration.

1) Annexure-I Scope of supply
Price with Commercial Terms and Condition

In case you need any further clarifications, please feel free to contact us.

We trust the above is as per your requirement and look forward to the pleasure of receiving your valued order.

Thanking you and assuring you of our best and prompt services at all times.

Yours faithfully,
For Pima Controls Pvt. Ltd.

Narendra Sisodia
Manager

ENCL : RA / Q-179 R1 / NGP

ANNEXURE-I
PRICE WITH COMMERCIAL TERMS AND CONDITION

PRICE

1) Baldor make Motors with following Specifications:

- **1500 RPM, 4 Pole**
- Enclosure: TEFC
- **Foot mounted, Premium Effi. Motor as per NEMA**
- Spec: 415 +/- 10%, 3 Phase, 50 Hz +/- 5%
- Motors are Inverter ready, Epoxy painted with Online Greasing arrangement.
- Efficiency measurement as per IEE112B Method

Sr. no.	Type	Description	Qty.	Unit price (Rs.)
1	18F215X412G1	• Motor Rating : 75 KW, 100 HP, • Frame Size : 280S • Full Load efficiency : 95.4%	1 No.	3,70,400/-

Please Note: Installation and Commissioning services would be charged extra at actual.

PRICE BASIS

FOR Ahmedabad **excluding** Excise Duty, Education CESS on BED, SHE Cess on BED (at present @10.3% charged) and SAD (at present @ 4% charged) of all above which is Modvattable. VAT plus Additional Tax (at present @ 15% charged), Freight or any other taxes / duties which if applicable will be charged extra at actuals. Insurance will be to your account.

TERMS OF PAYMENT

20% advance with order and balance 80% with 100% taxes and duties against Proforma Invoice. Proforma Invoice will be submitted in advance.

DELIVERY SCHEDULE

Within 10 to 12 week from the date of receipt of your technically and commercially clear order or advance payment whichever is later which will be confirmed depending on the motor selected by you.

WARRANTY

Warranty is 24 months from the date of Invoice.

VALIDITY

The offer is valid for your acceptance so that we receive your technically and commercially clear order within 30 days hereof. Beyond this, it will be subject to our confirmation in writing.

ORDER ACCEPTANCE

An order based of this offer is subject to our written acceptance and confirmation of the same.

Yours faithfully,

For Pima Controls Pvt. Ltd.

Narendra Sisodia
Manager

CC to: **KIND ATTN: MR. SHASHIBHUSHAN SUBHASH AGRAWAL**
KAPIL BUILDING, OPP. DR. NAIK'X X-RAY CLINIC
NEW BHAGWAT PLOTS, AKOLA (MAHARASHTRA) 444005

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

Petroleum Conservation & Research Association
Office Address :- Western Region
C-5, Keshava Building, Bandra-Kurla Complex; Mumbai – 400051
Website: www.pcra.org

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri, New Delhi-110058
Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com