Baseline Audit Report

Parayil Food Products Private LTD

1/781-802, Industrial Development area,
Aroor, Alleppy-688534, Kerala

BEE's National Program on Energy Efficiency in SMEs Kochi (Sea Food) cluster in XII plan

TÜV SÜD South Asia Pvt. Ltd.

May, 2016

Acknowledgement

TUV SUD South Asia Pvt. Ltd. is thankful to **Bureau of Energy Efficiency (BEE), Ministry Of Power** for providing us an opportunity to conduct Baseline audit in five units of Kochi Seafood Processing Cluster under the BEE SME Programme. We express our sincere Gratitude to the following officials of BEE

Shri Dr. Ajay Mathur –Director General

Shri Sanjay Seth– Secretary

Shri Milind Deore – Energy Economist

Shri Tarun Dixit – Project Engineer

We are extremely grateful to the officials of the **Seafood Exporters Association of India (SEAI)** for their support and cooperation. We extend

Our special thanks to **Mr. S. Ramakrishnan, Secretary of the SEAI** and **Mr. Alex Ninan, Vice President of the SEAI**.

We thank the **Parayil Food Products Private LTD** owner and their staffs for their support and cooperation during the baseline audit study.

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EXECUTIVE SUMMARY

1. Unit Details

Unit Name	Parayil Food Products Pvt Ltd.
Address	1/781-802, Industrial Development area, Aroor, Alleppy-688534, Kerala
Contact Person	Antony (Technical Manager) Phone:09947780025
Products	Sea Food & Agro
Contract demand	500 KVA

2. Existing Major Energy Consuming Technology

The major equipments in a typical seafood processing unit are compressors, condensers, cooling towers, freezers, ice making units, and the motors connected to these equipment. Compressors are the major energy consuming equipment in these seafood processing units.

Cold Storage:

After packing frozen material product will keep in cold storages at -18deg C temperature. Parayil Foods is having total 4 cold storages to keep products in required temperatures they installed and R22 which is the commonly used as coolant in the FCU's . Out of 4 cold storages 2 are using for Sea food an remaining 2 stores are using for agro foods.

3. Proposed Energy Saving Technologies with Cost Economics

a) Identified technology up gradation proposals

- Replacement of reciprocating compressor with Screw compressor with VFD
- Replacement of existing V-Belt drive with synthetic Energy Efficient flat belt/SPC saver drive in the compressor motor
- Installation of THERMOSHIPON SYSTEM (GAS COOLING) for Compressor.
- Automation of refrigeration plant by using PLC controller

Cost Economic analysis

S No	Recommendation	Annual Savings in kWh	Savings in INR	Investment in INR	Payback in Years
1	Replacement of reciprocating compressor with Screw compressor with VFD	197100	1227933	2000000	1.63
2	Replacement of existing V-Belt drive with synthetic Energy Efficient flat belt /SPC saver belt drive in the compressor motor	114975	724343	180000	0.25
3	Installation of THERMOSHIPON SYSTEM (GAS COOLING) for Compressor.	45990	287897	600000	2.08
4	Automation of refrigeration plant by using PLC controller	114975	719744	1200000	1.67
	Total	473040	2959916.4	3980000	1.3

b) Identified Energy Saving Proposals:

- Correction of automatic power factor controller

Cost Economic Analysis:

S No	Recommendation	Annual Savings in kWh	Savings in INR	Investment in INR	Payback in Years
1	Correction of automatic power factor controller	43 KVA	171756	105000	0.61

OBJECTIVE OF BEE SME PROGRAM

The BEE SME Program aims to improve Energy Efficiency (EE) in SME sector by technological interventions in the various industrial clusters in India. The EE in SMEs is intended to be enhanced by helping the industries in the 25 energy intensive SME clusters by:

- Technology interventions
- Implementation of EE measures and projects in clusters, and
- Capacity building for improved financial planning for SME entrepreneurs

The program also aims at creating a platform for dissemination of the appropriate practices and the appropriate technologies available in the market for energy efficiency and conservation, to create awareness in the clusters, and to demonstrate the new technology interventions/ projects to stimulate adoption of similar technology/projects in the clusters. The BE E SME program has been designed in such a way that it addresses the specific needs of the industries in the SME sector for EE improvement and to overcome the common barriers in the implementation of EE technologies in cluster through knowledge sharing, capacity building, and development of innovative financing mechanisms.

The major activities for which we need to give support to BEE's National Program on Energy Efficiency in SMEs Kochi (Sea Food) cluster in XII plan are:

- Conducting pre-activity cluster workshop.
- Conducting initial Baseline audits to get an overview of the technology presently existing in the Seafood processing units in Kochi.
- Identify areas of energy saving, both without & with investment and propose to BEE two energy efficient process technologies.
- Identify at least 5 Local technology/ service providers for the above technologies in the cluster
- Identify 20 SME units willing to implement and demonstrate the above two technologies
- Assist BEE to enter into a contract with each of the 20 shortlisted SME units
- Conduct comprehensive Baseline Energy Audits in 20 SME units
- Development of technology specific case studies for each technology
- Preparing Best Operating Practices(BOP) document for the top 5 energy using equipment/ process
- Carry out post implementation energy audit in each of the above 20 units
- Verify and submit to BEE all the relevant documents of each participating unit
- Assist BEE in conducting five post energy audit training workshops

BRIEF ABOUT UNIT

Parayil Food Products Pvt Ltd have been successful in bringing traditional authentic dishes from India to "Pravasis" all around the world, evoking nostalgia about one's roots, homeland and foods, that are craved for. From the bounty of the oceans to the harvest of the earth, we make food that is synonymous with hygiene, use of latest technology in preservation, quality and taste that you might forget that they were frozen. Indian Seafood Industry is now more than 48 years old. In order to sustain and flourish in the market place, we believe that a culture of change needs to be imbibed. We take special care, especially about the evolving customer needs and the fulfillment thereof, in the most cost effective manner. As a first step towards the realization of our aspiration, our products are a paradigm of perpetual quality competence. We are committed to enhancement of the value we offer to our customers and, working hard to adopt new ways not only of understanding what customers want, but also anticipating their needs and of responding with innovative offerings.

Being highly perishable food material, Seafood calls for extreme care in its handling and preservation for international markets. Our processing time is always under stringent mechanism, which makes it mandatory that all our products are processed according to HACCP guidelines. Size grading and packing are done as required by the customers. Products are exported in fresh and frozen conditions.

"Seafood Delight" proudly claims…. If it's in sea, it's on our list. For consistent supply of an array of specialty fish, we have an integrated cold storage facility of 4000 tones and room for another 4000 tones for future expansion.

Technology overview of typical sea food processing unit

1. Compressors :

It is noticed that reciprocating compressors are being used in the chilling unit. Reciprocating compressors consists of a piston moving back and forth in cylinder, with suction and discharge valves to achieve suction and compression of the refrigerant vapor. The suction side of the compressor is connected to the exit of the evaporator, while discharge side of the compressor is connected to condenser inlet. The performance evaluation of the compressors (KW/TR) should be done regularly in order to monitor the performance of the same.

2. Condenser :

It is observed at the time of audit, evaporative condensers are being used in the plant:

The above mentioned condenser is being used in the HVAC system to the cool ammonia which is the commonly used coolant in the plant for freezers. The detailed analysis and performance evaluation of condenser will be discussed in refrigeration system chapter.

Evaporative condenser:

The evaporative condenser is one of the energy efficient models compared to other type of condenser used in the processing unit. The vapor to be condensed is circulated through the condensing coil, which is continually wetted on the outside by a recirculating water system. Air is pulled over the coil, causing a small portion of the recirculating water to evaporate. The evaporation removes the heat from the vapor in the coil, causing it to condense.

3. Freezers

It is noticed at the time baseline audit that the following type of freezers are being used in the Parayil foods processing unit

i) Plate freezer
ii) Blast freezer

Plate freezer:

Plate freezer are commonly used for freezing brick shaped packaged products. In plate freezers, the refrigerant is allowed to circulate inside the thin channels within the plates. The packaged products are firmly pressed between the plates. High rates of heat transfer can be obtained between the packed product and the refrigerant plates

Blast Freezer:

Blast freezer is commonly used freezer in sea food processing unit in which blower is being used to supply the cold air over the product in order freeze the product. The temperature range will be in the range of -40 deg C and the air speed over the product will be high, to get good heat transfer.

4. Other equipments:

In addition to the above processing equipment, ice making unit and chilled water base cooling systems are also being used in the plant for processing area cooling purpose.

Energy & Production Situation in the Unit

Energy scenario:

It is noticed during the course of audit that two type of energy is being used in the plant, which are electrical energy and thermal energy. The electricity is drawn from the Kerala state electricity board (KSEB) and Diesel generators are being used in the plant as a back system to meet the demand in case of grid supply failure or scheduled power cut from the grid

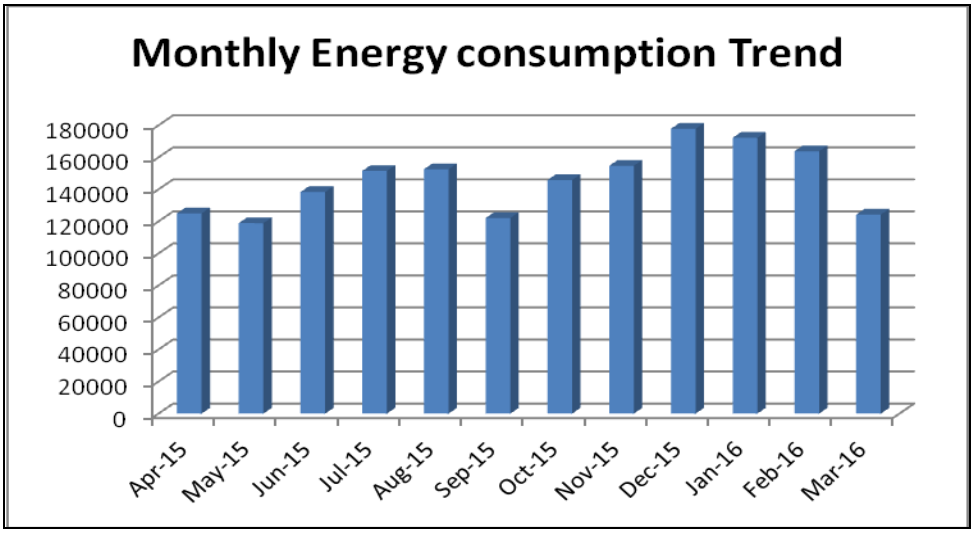
Energy consumption of the plant

The primary source of energy is electricity and that is imported from the KSEB and diesel generators are being used as an back system during power failure. Parayil is having Sea food processing and Agro foods also. There is common connection for both process there is no separate connection for Sea food processing area. Month wise electricity consumption of the total plant (Sea food and Agro) details is as follows:

S. No	Month & Year	CMD (KVA)	RMD (KVA)	KWh	KVAh	P.F	Total Bill(Rs)	P.F incentives/ penalty	Unit cost (Rs/KWh)
1	Apr-15	500	417	125046	138204	0.90	778874	0	6.23
2	May-15	500	420	118938	131568	0.90	753635	0	6.34
3	Jun-15	500	413	138348	155658	0.88	942506	7105	6.81
4	Jul-15	500	478	151536	178890	0.84	994354	38708	6.56
5	Aug-15	500	473	152604	178176	0.85	963074	30849	6.31
6	Sep-15	500	446	122172	137922	0.88	777972	6226	6.37
7	Oct-15	500	437	145878	158214	0.92	903254	-3788	6.19
8	Nov-15	500	466	154746	166338	0.93	963332	-6067	6.23
9	Dec-15	500	428	177858	189006	0.94	1071103	-9294	6.02
10	Jan-16	500	443	172218	181764	0.94	1027660	-11053	5.97
11	Feb-16	500	405	163788	172842	0.94	970008	-10481	5.92
12	Mar-16	500	409	124248	134058	0.92	770089	-4773	6.20
	Total			**1747380**	**1922640**		**10915861**	37432	
	Avg			**145615**	**160220**	**0.90**	**909655**		**6.26**

The electricity consumption of the plant is varying from 1.18 Lakh kWh/month to 1.77 Lakh kWh/month and average electrical energy cost for the plant is 6.26 Rs/KWh

Monthly Variation of Electricity Consumption during the year 2015-16.



Diesel Generators:

Diesel generators are being used in the plant (Agro and Seafood plants) as a back system to meet the demand in case of grid supply failure or scheduled power cut from the grid. Month wise consumption and generation details of the plant are as follows:

S. No	Month & Year	Diesel(Ltrs)	KWh	cost(Rs)
1	Apr-15	701	2103	42056
2	May-15	756	2268	45360
3	Jun-15	757	2270	45400
4	Jul-15	-	-	-
5	Aug-15	-	-	-
6	Sep-15	637	1912	38232
7	Oct-15	658	1974	39472
8	Nov-15	329	987	19744
9	Dec-15	664	1992	39836
10	Jan-16	-	-	-
11	Feb-16	953	2860	57208
12	Mar-16	-	-	-
		5455	**16365**	**327308**

It is seems to be diesel consumption of plant is nominal only

Production scenario:

Power consumption is common for both Agro and Sea food industry, so we are considering both production details as there is common cooling system for both plants. Production details for the FY 2015-16 are given below.

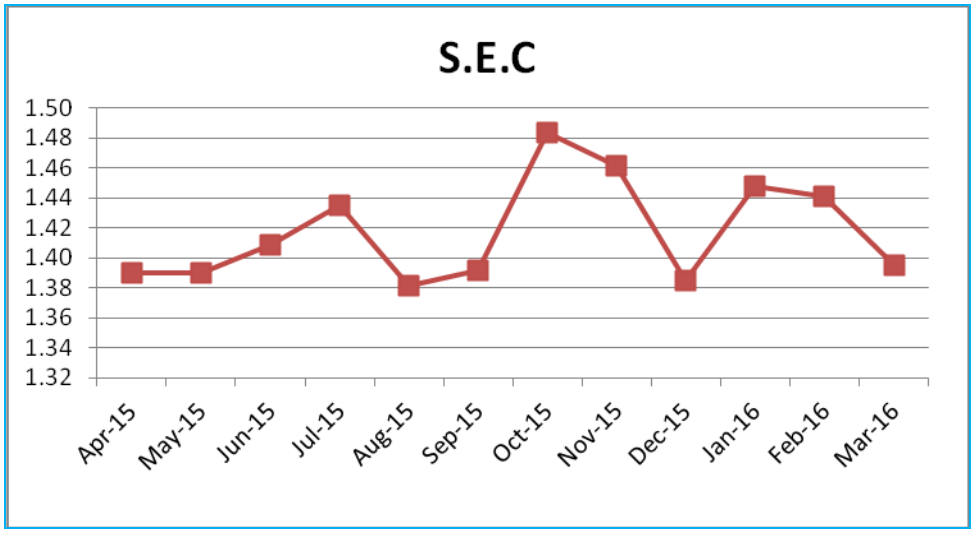
S. No	Month & Year	Production
1	Apr-15	91500
2	May-15	87190
3	Jun-15	99850
4	Jul-15	105600
5	Aug-15	110500
6	Sep-15	89150
7	Oct-15	99680
8	Nov-15	106540
9	Dec-15	129870
10	Jan-16	118950
11	Feb-16	115620
12	Mar-16	89065
		1243515

Specific Energy Consumption:

The specific energy consumption unit range from 1.38 kWh/kg of the product to 1.45 kWh/kg of the product.

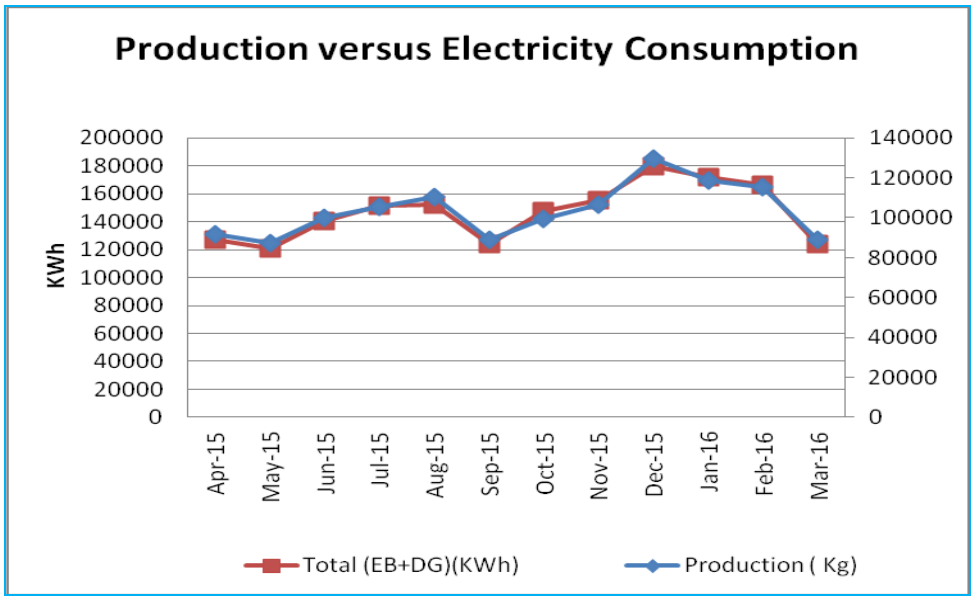
S. No	Month & Year	Production (Kg)	Total (EB+DG)(KWh)	S.E.C(KWh/Kg)
1	Apr-15	91500	127149	1.39
2	May-15	87190	121206	1.39
3	Jun-15	99850	140618	1.41
4	Jul-15	105600	151536	1.44
5	Aug-15	110500	152604	1.38
6	Sep-15	89150	124084	1.39
7	Oct-15	99680	147852	1.48
8	Nov-15	106540	155733	1.46
9	Dec-15	129870	179850	1.38
10	Jan-16	118950	172218	1.45
11	Feb-16	115620	166648	1.44
12	Mar-16	89065	124248	1.40
		1243515		**1.42**

Monthly Specific Energy consumption Variation for the year 2015-16



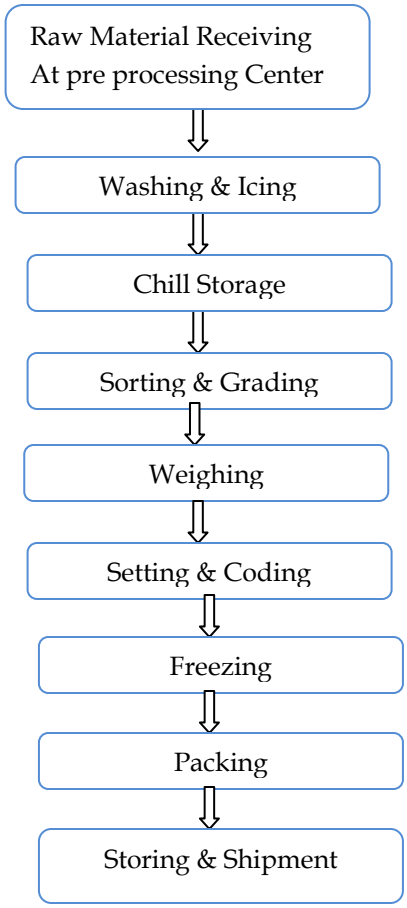
It is seems to be October month accounts for largest Sepific energy consumption 1.48 KWh/kg and fallowed by November and january months .

Monthly Variation in Production versus Electricity Consumption for the year 2015-16



Process flow diagram

The typical process followed in the seafood processing industry is shown in the flowchart below. For all of the units surveyed, the preprocessing of fish was done outside the units and the operations in the units started with the cleaning of preprocessed/ cleaned fish. While most of the units follow the general process of cutting, cleaning, grading, weighing, freezing, packing, and storing; the difference arise in the way fish is frozen and the freezers used for the purpose.



From the flowchart, it can be inferred that the energy intensive steps in the process are the freezing and the storage. Freezing alone accounts for nearly 75% of all the electricity consumed in the unit.

Condenser Analysis

The major equipments in a typical seafood processing unit are compressors, condensers, cooling towers, freezers, ice making units, and the motors connected to these equipment. Compressors are the major energy consuming equipment in these seafood processing units.

Parayil Foods have installed direct contact water cooled condenser in their HVAC system to cool the ammonia which is the commonly used coolant in the unit.

As a part of audit we conducted performance evolution of refrigeration system, there are 6 compressors installed in Parayil Foods to meet the cooling load requirements.

S. No	Description	Design	Measured				
		Rating(HP)	V	A	KW	P.F	KVA
1	Compressor-1	75	Not working				
2	Compressor-2	60	Not working				
3	Compressor-3	60	401	85.5	59	0.92	64
4	Compressor-4	75					
5	Compressor-5	100	419	90.3	58	0.91	64
6	Compressor-6	100	Not working				

By the time of audit only one blast freezer is working, to estimate cooling load of freezer can be calculated using the formula given below:

Heat rejected at condenser = Cooling load + Work done by compressor

$$\text{Heat Rejected (TR)} = (\text{Evaporator TR}) + \frac{\text{kW}}{3.516}$$

$$\text{Heat rejected (TR)} = \frac{\text{Mc x } C_p \times (t_{wo} - t_{wi})}{3024}$$

There are 2 Evapco condenser units installed for total 6 compressor. Based on heat load units will come in to active mode automatically.

Unit1: 15 HP fan and 1.5 HP pump for cooling water circulation
Unit2: 7.5 HP fan 2 no's and 1.5 HP pump for cooling water circulation

Performance evaluation of refrigeration System

Parameter	Unit-1	Unit-2
Mass flow Rate of cooling water M3/h	30603	Not Working
inlet air temp deg C	33.8	
Outlet air temp deg C	35.2	
Inlet air Humidity %	67.8	
Out let air Humidity %	90.4	
Inlet air enthalpy KJ/KG	85	
Outlet air temp KJ/KG	115	
Specific heat of air kg/m3 deg C	1.23	
Condenser-Heat Rejected (TR)-Measured	90	
Compressor (KW)-measured	117	
Evaporator (TR)-Measured	56	

Cooling Tower analysis:

Cooling tower is using to cool the compressor head, there is a common cooling tower for all compressors, and detailed analysis is given below:

Parameter	Unit	CT
CW top temp	^{0}C	35
CW basin Temp	^{0}C	32
wet Bulb Temp	^{0}C	24
Effectiveness	%	27.3

It is seems to be cooling tower heat transfer area (fills) are found inefficient. During the rainy season and winter there is not much of a problem. Where as in summer, they needs to be cleaned periodically to improve their performance

Cold storage:

After packing frozen material product will keep in cold storages at -18deg C temperature. Parayil Foods is having total 4 cold storages to keep products in required temperatures they installed and R22 which is the commonly used as coolant in the FCU's . Out of 4 cold storages 2 are using for Sea food and remaining 2 stores are using for agro foods.

Details of units are given below:

Parameter	Cold Storage-1	Cold Storage-2	Cold Storage-3	Cold Storage-4
Serving Area	Sea food	Sea food	Agro Food	Agro Food
Capacity	22TR	22TR	22TR	22TR
No. Of units	4	4	4	4

Power Measurement details of cold storage and ante rooms are given below:

S. No	Cold store	Unit no's	Power Measurement details				
			V	A	KW	P.F	KVA
1	Cold store-1	unit-1	417	33.5	15.8	0.65	24.3
2	Cold store-1	unit-2	415	26.1	14.6	0.76	19.2
3	Cold store-1	unit-3	411	34.9	21.6	0.82	26.3
4	Cold store-2	Unit-1	417	27.2	16.2	0.83	19.5
5	Cold store-2	Unit-2	416	32.9	15	0.64	23.4
6	Cold store-2	unit-3	415	34	21	0.84	25.0
7	Ante room	unit-1	414	24.3	13.2	0.76	17.4
8	Ante room	Unit-2	415	23.9	13	0.78	16.7

Performance evolution of Sea food cold storage FCU's are given below:

S. No.	DESCRIPTION	Cold storage-1			Cold storage-2			Ante room	
		Unit-1	Unit-2	Unit-3	Unit-1	Unit-2	Unit-3	Unit-1	Unit-2
1	Air density(Kg/m3)	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
2	Air flow(m3/h)	4766	5268	4264	4515	4590	4390	4390	4214
3	Supply air temp deg C	-16	-16	-14	-16	-15	-14	14	12
4	Return air temp deg C	-9	-10	-7	-9	-8	-7	17	15
5	TR	14.23	13.48	12.73	13.48	13.71	13.11	5.06	5.39
6	KW	15.80	14.60	21.60	16.20	15.00	21.00	13.20	13.00
7	KW/TR	1.11	1.08	1.70	1.20	1.09	1.60	2.61	2.41
8	COP	3.16	3.24	2.07	2.92	3.21	2.19	1.34	1.46

From the above table we can observe that Net refrigeration capacity of the AC system varies from 12 to 13 TR. Also the range in kW/ TR is observed to be little bit high in unit -3 and the COP varies from 2.07 to 3.16 .

Ante Room: Net refrigeration capacity of the AC system varies from 5 to 5.4 TR. Also the range in kW/ TR is observed to be little bit high in unit -1 and the COP varies from 1.34 to 1.46 as units are installed in very interior hot air is circulating over condenser , so less heat rejection taking place at condenser coil . it is suggested to install outdoor units in fresh air zone.

IDENTIFIED TECHNOLOGY UP GRADATION PROPOSALS

1) Replacement of reciprocating compressor with screw compressor with VFD

Present status:

Ammonia based reciprocating compressor is being used in plant for cooling purpose. Compressors are coupled with motor through V belt drive. There are total 6compressors with different ratings details are given below:

S. No	Description	Rating(HP)
1	Compressor-1	75
2	Compressor-2	60
3	Compressor-3	60
4	Compressor-4	75
5	Compressor-5	100
6	Compressor-6	100

Observation

- The specific energy consumption of reciprocating compressor is varying from 1.5 KW/TR to 2 KW/TR.
- The specific energy consumption of screw compressor will vary from 0.85 kW/TR to 1 kW/TR
- Compressors are not operated to their full capacity due to less capacity utilization of the plant.

Recommendation:

It is recommended to replace the reciprocating compressor with screw compressor in order to reduce the specific energy consumption to certain level and that will result in considerable amount of energy savings.

Saving percentage:

Saving percentage will be 10-20%

Investment:

Investment amount will be in the range of 20 Lakhs.

Payback:

Payback period will be in between 1.5 to 2 years.

In general 4 compressors are running to meet cooling requirement, it is suggested to replace 2*45 KW and 2*55 KW reciprocating compressor with screw compressors, calculation has been mentioned below:

S. No.	Particulars	Units	Value	Value
1	Capacity of the reciprocating compressor	kW	45	55
2	Number of compressors	no's	2	2
3	Actual power consumption of 4 compressors	kW	200	
4	Expected power consumption by screw compressor with VFD(@15% saving)	KW	170	
5	Savings in kW	kW	30	
6	Operating hours	hours	18	
7	Savings in kWh per annum	kWh/Annum	197100	
8	Savings in Rs	Rs	1227933	
9	Investment	Rs	2000000	
10	Payback	Years	1.63	

2) Replacement of existing V-Belt drive with synthetic Energy Efficient S.P.C Saver belt in the compressor motor

Present status:

Compressor motors are connected with compressor through V Belt drive. Compressors are most energy consumer of sea food processing unit and the operating time of the compressors are varying from 15 to 18 hours per day.

Observation:

- Use of V belt causes some energy losses. There are power transmission losses of about 5-7%.
- The latest trend in the industry is to replace the V Belt drive with S.P.C Saver belt and these belts have the following advantages:

  i. Non-hygroscopic - prevents elongation due to moisture absorption

  ii. Ensures better grip on the pulley

Recommendation:

- It is recommended to replace the V belts with flat belt in order to reduce power transmission losses and this will result in considerable amount of energy savings.
- The energy saving calculation for 6 number of compressors which is operating with V belt drive has been mentioned below as a sample calculation:

S. No.	Particulars	Units	Value
1	Total Capacity of the motors	kW	350
	Actual power consumption with V belt	kW	263
3	Projected consumption with flat belt	kWh	236
	Savings in kWh	kWh	26
5	Total No. of compressors	Nos	6
	Operating hours	hours	12
7	Savings in kWh per annum	kWh/Annum	114975
	Savings in Rs	Rs	724343
9	Investment	Rs	180000
	Payback	Years	0.25

3) Installation of THERMOSHIPON SYSTEM (GAS COOLING) for Compressor.

Present status:

At the time of audit, it is observed that unit is using water cooled Cooling system for compressor. Cooling water is circulating on compressor head to cool down compressor temperature. Separate Pump installed and running continuously for circulating cooling water for compressor cooling.

Observation:

- Cooling towers are filled with algae formation and that will affect the effectiveness of the cooling towers.
- Thermoshipon system is a new technology developed for compressor cooling. It will improve the work done compressor and efficiency.

Recommendation:

It is recommended to install Thermoshipon system for compressor cooling in order to save substantial amount of energy savings.

Percentage Saving:

Saving percentage will be at least 1-2 %.

Investment:

Investment amount will be in the range of 6 Lakhs.

Payback:

Payback period will be in around 2 year.

S. No.	Particulars	Units	Value
1	Capacity of the Present reciprocating compressors	kW	350
2	Number of compressors	no's	6
3	Expected power consumption by installation of Thermoshipon system (@2% saving)	KW	7
4	Operating hours	hours	18
5	Savings in kWh per annum	kWh/Annum	45990
6	Savings in Rs	Rs	287897
7	Investment	Rs	600000
8	Payback	Years	2.08

4) AUTOMATION of refrigeration plant by using PLC controller:

Present status:

At Present Refrigeration system is controlling in manual mode only. Based on temperature requirements refrigerate flow controlling with the help of opening and closing values manually by operators.

Observation:

- while operating manually error may occur, it will cause power loss.
- We can program When to stat and when to stop in Automatic system .
- PLC will control Loading and unloading of compressors automatically.

Recommendation:

It is recommended to install PLC based automatic system to save substantial amount of energy .

Percentage Saving :

Saving percentage will be at least 5 %.

Investment:

Investment amount will be in the range of 12 Lakhs.

Payback:

Payback period will be in around 1.5 year.

S. No.	Particulars	Units	Value
1	Capacity of the Present reciprocating compressors	kW	350
2	Number of compressors	no's	6
3	Expected power consumption by installation of PLC controlled Automation system (@5% saving)	KW	17.5
4	Operating hours	hours	18
5	Savings in kWh per annum	kWh/Annum	114975
6	Savings in Rs	Rs	719744
7	Investment	Rs	1200000
8	Payback	Years	1.67

IDENTIFIED ENERGY SAVING OPPORTUNITIES

1) Correction of automatic power factor controller

Observation:

It is observed that the power factor of the plant is varying from 0.85 to 0.95 . Automatic power factor controller installed to maintain the power factor close to unity. but in APFC panel is not working effectively as installed capacitors may be De-rated an programming need to change.

Working of Automatic power factor controller:

Automatic power factor controller has microcontroller based programmable controller which switches the capacitor bank of suitable capacity automatically in multiple stages by directly reading the reactive load of the plant.

Recommendation:

It is recommended to correct the installed automatic power factor controller (replacement of faulty capacitors an need to correct the controller) in the plant in order to improve the power factor close to unity that will result in considerable amount of energy savings. Kerala State Electricity board power factor improvement policy is given below:

Power Factor Range	Incentives
0.90 to 1.00	0.15 % of energy charges for each 0.01 unit increase in power factor from 0.9 p.f

Power Factor Range	Penalty
For power factor below 0.90	1% energy charge for every 0.01 fall from 0.90 p.f

The quantification of energy saving by sample calculation method has been tabulated as below:

S. No.	Particulars	Units	Value
1	Average Monthly energy charges	Rs	909655
2	Actual power factor of the plant	PF	0.9
3	Desired power factor of the plant	PF	0.999
4	Required KVAR	kVAR	175
5	Actual Apparent power of the plant	kVA	436
6	Apparent power after improvement of power factor	kVA	393
7	Savings in kVA	kVA	43
8	Savings in Rs/Month	Rs	12962
9	Savings in Rs/ Annum	Rs	155546
10	Savings in Amount as a power factor Incentives Rs/Month	Rs	1351
11	Savings in Rs/ Annum	Rs	16210
12	Total cost Savings	Rs	171756
13	Investment	Rs	105000
14	Payback	Years	0.61

Conclusion

Based on our audit in the Parayil Foods processing unit and above given energy saving opportunities in detail we are recommending the below given energy efficient technology up gradation in the Parayil Foods International

1. Replacement of reciprocating compressor with screw compressor with VFD
2. Replacement of existing V-Belt drive with synthetic Energy Efficient S.P.C Saver belt in the compressor motor
3. Installation of THERMOSHIPON SYSTEM (GAS COOLING) for Compressor.
4. Automation of refrigeration plant by using PLC controller

The total investment cost is 20 Lacs, after successful implementation of any project; the plant will get the subsidiary amount of Rs. 10 Lac from BEE

The summary of the savings plans are given below:

S. No	Recommendation	Investment in INR	Eligible Subsidiary amount in INR
1	Replacement of reciprocating compressor with Screw compressor with VFD	2000000	1000000
2	Replacement of existing V-Belt drive with synthetic Energy Efficient flat belt drive in the compressor motor	180000	
3	Installation of THERMOSHIPON SYSTEM (GAS COOLING) for Compressor.	600000	
4	Automation of refrigeration plant by using PLC controller	1200000	

The BEE will provide subsidiary amount of Rs.10 Lacs per plant and will not provide more than ceiling amount of Rs.10 Lac

Equipments Suppliers Contact Details

Compressors & Condensers	
Kirloskar Pneumatic Co Ltd. 1st Floor, Elcanso Building, 10, Casa Major Road, Egmore, Chennai-600 008 Phone: 044-28193066, 2890436, 2892092 Fax: 044-28194397 E-mail: kpclchnacd@kpcl.net	**Elgi Equipment Limited** #39/3973, Pallimukku, M.G.Road, Kochi – 682016. Tel (0484) 2360155 Fax (0484) 2351904 E-mail : enquiry@elgi.com
Frick India Limited 41/3273-D, Golden Castle Bldg. Old Railway Rd., Cochin - 682018. Phone: 0484-2394173 E-mail: cochin@frick.co.in	**Johnson Controls (India) Pvt. Ltd.** C/ o. York India Limited, Delphina Building 2nd floor CMH Road, Indiranagar Stage 1 Bangalore, Karnataka 560 038 India Ph: +91 (80) 3057 5730 Fax: +91 (80) 3057 5729
Evapco Condensor ACS Consultancy Pvt . Ltd 276/ 5, Sangam Apartments Belly Area, Anna Nagar West Chennai-40, India Ph: (91) 9840818637 / 9444048480 Fax: (91) 44-42026477 Email: evapco-india@airtelmail.in	**Lloyd Insulations (India) Limited,** 38/ 449, Panampilly Nagar Manorama Junction, Ernakulam, Kerala 680036 Ph: +91 (484) 2324472
Bombay Ammonia Sales Corporation B-17, Rishabh Shri House, Ranjeet Nagar Commercial Complex, New Delhi – 110 008	**Vision Engineering Madras Pvt. Ltd.** No 6/1, Shanthi Nagar Main Road, Ramapuram, Chennai - 600089, Opposite Dlf & Moonlight Phone: +(91)-44-22492800, 22490801, Mobile: +(91)-9444040948, 9444040946, 9444040950
Baltimore Aircoil Condensor Densol Engineering Pvt . Ltd. #43/ C, 9th Main, R P C Layout Vijayanagar 2nd Stage Bangalore 560040	
Belts **Beblec (India) Private Limited** Plot No. 126, Sipcot Indlustrial Complex Hosur - 635 126 Tamil Nadu, India	**Belts** **Anjanaa Belting** 3857, TNHB, Ayapakkam, Chennai – 600077 Ph: +91-44 – 64991300/ 9840186799

Sagar Electric Power Services #70, K. Kamaraj Road, Bangalore, India—560042 Ph: +91 9060133874; 9448073258	**Vijay Energy Products Pvt.Ltd.** SP – 75, Ambattur Indl. Estate Chennai – 600 058 044 – 625 4326
Pumps **BI Marketing & Services Pvt Ltd** Dealer: Grundfos Pumps No.50, 3rd street, East Abhiramapuram, Chennai – 60004 Ph: +91-44-24671267	**VFD's** **Enpro Industrial Automation Pvt Ltd.** Dealer: Danfoss VFD F18 Ambattur Industrial estate, Ambattur Chennai – 600058 Ph: +91-44-26244583; 26244865;26359850 email: projects@enproautomation.com
Motors **Project & Supply** A – 605, Sunswept Lokhandawala Complex Swami Samarth Nagar,4, Bungalow, Andheri (West) Mumbai 400 050,Ph: 022 – 626 6584	**Motors** **Kirloskar Electric Co. Ltd** 294 – 295, Lloyd's Road, Royapettah. Chennai –14. Ph: 044 – 28133176
Motors **Siemens Ltd** 3rd Floor, Jyoti Mahal, No. 49, St . Marks Road, Bangalore 560 001 +91 80 5119 1500 Ph: +91-4344-276358 / 278658 / 400688 /400687	**Capacitors** **Momaya Capacitors** 401, Madhav Apartments Jawahar Road, Opp.Rly.Stn. Ghatkopar (East) Mumbai – 400 077,Ph: 022 – 516 2899 / 1005 / 0745
Insulation	
India Insulations NH Bypass, Vytilla, Kochi – 682 019, Kerala Ph: +91 (484) 2304465	**Thermax Limited,** RNG Pallazzo, No. 1, 1st Floor South End Street Kumarapark East Bangalore 560 001 Ph: +91 (80) 22371721,Fax: +91 (80) 22371726
For Ice Storage System:	
Balamurugan Refrigeration Engineers, Liveiro building, Thoppumpady Kochi 5	**GEA Refrigeration India Pvt. Ltd.** Branch Office- 5th Floor, Lohia Jain Business Centre, Friends' Park Society, Senapati Bapat Road ,Pune –

Ph: +91 (484) 2231844	411016 India
ACS Refrigeration 272/5, Sangam Apartments, Belly Area, Anna Nagar west., Chennai – 600040. Tamil Nadu, India. Mob No:- 09840818637, Tele Fax:: 044-42026477 Email : sales@acsref.com	

The service providers were selected considering the technology recommended and their ability to service the sea food processing units located in Kochi. Since not all service providers have dealership network in Kochi, hence dealers have been selected from Chennai & Bangalore.