First Prize *Petrochemicals*

INDIAN PETROCHEMICALS CORPORATION LIMITED
Gandhar Complex, Bharuch (Gujarat)

Unit Profile

Indian Petrochemicals Corporation Limited with management control by Reliance Petroinvest Co. and one of the Navratnas established in 1969 by Govt. of India is leading entity in corporate circles of India. IPCL's mutiproduct portfolio includes Polymers, Synthetic Rubber, Synthetic Fibre & Fibre Intermediates, Solvents, Industrial Chemicals, Synthetic Resins, Engineering Plastics, Catalysts, Absorbents, and Wire & Cable Compounds. IPCL have manufacturing facility at three locations, (a) Baroda in Gujarat, (b) Nagothane in Maharashtre, (C) Gandhar near Bharuch in Gujarat.

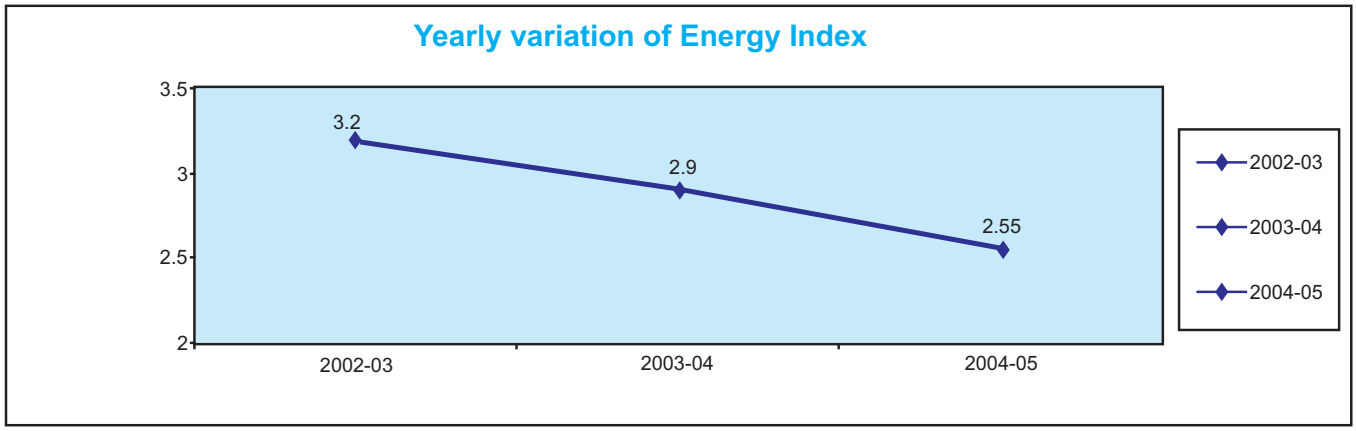
GANDHAR COMPLEX:
Gandhar Complex is the youngest complex of IPCL (1996) spread over 800 hectares of land at estuary of Narmada.Have own captive jetty and well connected with GCPTCL and manufacturing facilities of ethylene, propylene, EO-EG, HDPE, PVC, VCM , Caustic & Chlorine. The complex houses the country only chlorine integrated PVC manufacturing facility backed by captive power plant and Gas Cracker unit. Power & Steam generation capacity is 154.5 MW & 540 MT/hr.

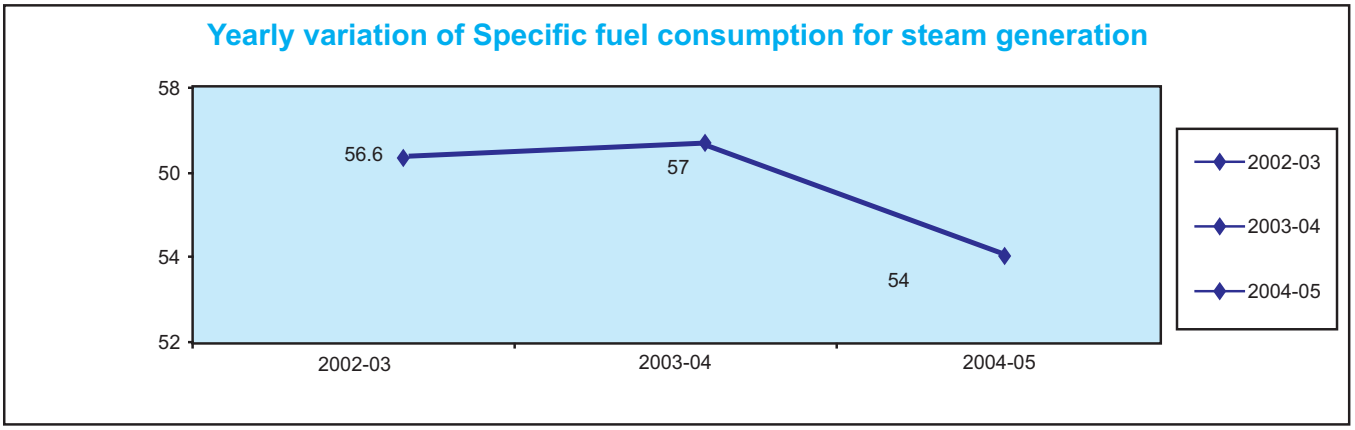
Energy Management Policy

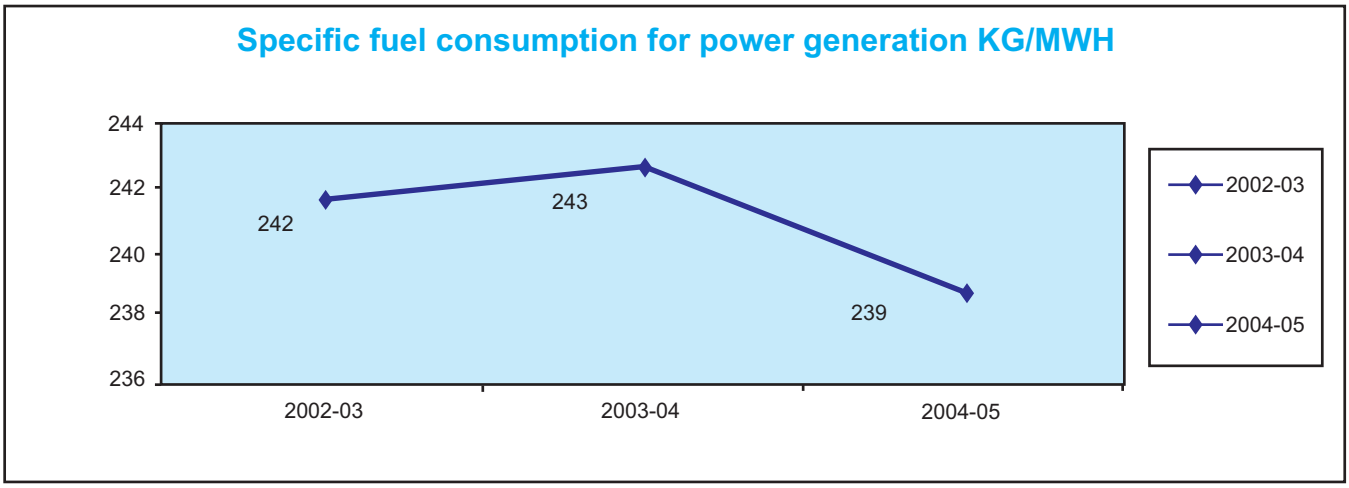
- Mimimise use of energy and its purchased cost by continuous measuring and controlling the energy index and its cost
- Promote energy awareness culture in the organization and imbibe habits of improved house keeping and waste elimination.
- Carry out periodic energy audit and implement identified improvements.
- Benchmark continuously our performance against the best in the industry.
- Make best endeavour for the development and use of renewable sources of energy.

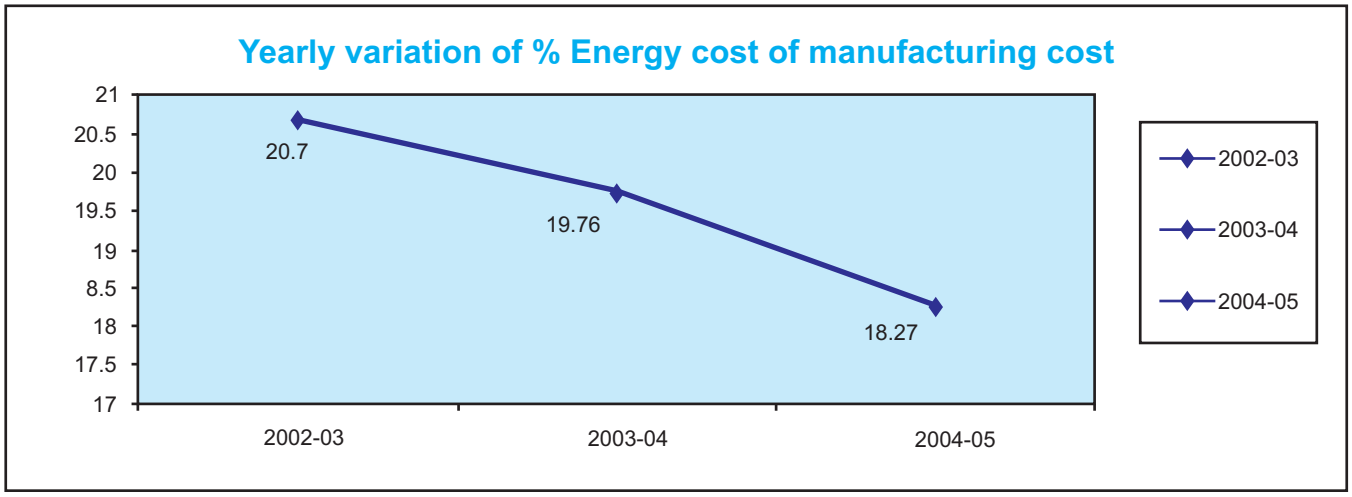
Energy Consumption

Following trends shows about energy consumption for the complex:









All reducing trends reflect the story of energy conservation efforts taken up at IPCL- Gandhar complex.

Energy Conservation Achievements

Few energy conservation schemes implemented in 2004-05 are listed below. Biggest achievement for the year 2004-05 is that plant energy index reduced by 12% as compared to previous year.

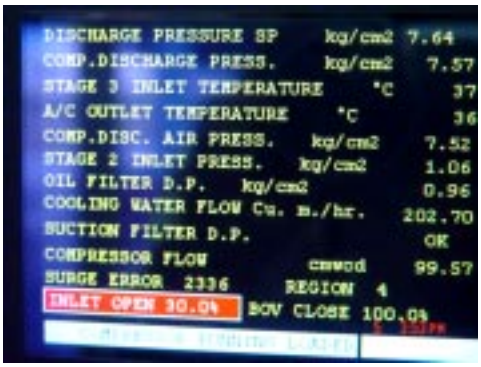
1. Utilization of excess CA hydrogen as a fuel in boilers to generate steam.

In chlor alkali plant hydrogen at low pressure is produced as a by product. partially it is being used in CA plant furnace and rest is being vented. As this available hydrogen is at low pressure it cant be used in furnace, Two number of reciprocating compressors of 1500 nm3 each with a discharge pressure of 4.5 kg/ cm2g is installed and this pressurised hydrogen is used as fuel in boilers for generating steam, burners are designed for 49-71 mole % hydrogen.

Hydrogen saved	:	2384 MT/annum
Equal Naphtha Saved	:	6566 MT/annum
Total saving Rs lacs / annum	:	1180
Investment Made	:	460
Payback period	:	5 months

2. Reduction in air compressor discharge pressure from 8.2 -7.8 kg/cm2.

For catering demand of instrument air, plant air and process air two numbers of centrifugal air compressors are in operation with discharge pressure of 8.2 kg/cm2g. Meeting of all instrument manager done and decision is taken that at farthest point pressure should be 6.5 kg/cm2g. Gradually in steps pressure is reduced from 8.2- 8.1- 8.0- 7.9- 7.8 kg/cm2 g.



Annual power saved : 9.6 lacs KWH
Total saving Rs lacs / annum : 34.9
Investment Made : Negligible
payback period : Immediate

3. Operating philosophy of CPP-1 & CPP-2 Modified based on incremental fuel firing concept. & Optimization of excess O2 in flue gas of Utility boilers & HRSG's.

Operating philosophy of CPP-1 & CPP-2 Modified based on incremental fuel firing concept.We have two captive power plants CPP-1 & CPP-2 with following configuration CPP-1 GT-1 (frame-6)(30.5 MW) HRSG-1 (100 MT/hr) UB-1&2 (100 MT/hr) STG (34.0MW)
CPP-2 GT-2&3 (45 MW each) LM6000 HRSG 2 &3 (120MT/hr each)

To meet the power and steam requirement all four turbines and five steam generators are in operation, due to different type of turbine the open cycle heat rate of turbine are different hence flue gas temperatures are different. Temperature of flue gas for Frame-6 is 550 0c and 440 0c for LM -6000 machine. In HRSG 's specific fuel consumption for supplementary firing is always less than in Utility boilers. But if calculations are done for incremental fuel firing for incremental steam generation than increase in HRSG-02/03 fuel is higher than utility boilers. in case of total naphtha firing increase of load should be the following order. HRSG-01 (100 MT/hr) -HRSG-02&3 (75 MT/hr)-UB-01/02(Upto100 MT/hr) .

Equivalent Naphtha saved/ annum : 7738 MT
Total saving Rs lacs / annum : 1394
Investment Made : Negligible
payback period : Immediate

4. Segregation of high & low pressure air requirement users:
After reducing the pressure of air upto 7.8 kg/cm2 g thought of segration of low and high pressure consumer comes into mind, after a lot of discussion decision had been taken to install a new air compressor for CA plant where the requirement of air pressure is only 3.5 kg/ cm2g. Now CA instrument air consumption is met by new compressor only at 3.5 kg/cm2g.

Annual power saved : 16.8 lakhs kWh
Total saving Rs lacs / annum : 61
Investment Made : 50
payback period : 10 Months

5. Use of waste flash steam in HDPE plant VAR machine.

In HDPE plant flash steam is generated at atmospheric pressure, this very low pressure steam is tapped from atmospheric condensate tank and used in vapour absorption system and hence reduces the LP (4.0 kg/cm2g) steam consumption.

Equivalent naphtha saved/ annum : 178 MT
Total saving Rs lacs / annum : 32
Investment Made : 3
payback period : 1.2 Months

6. Bypassing of raw water reservoir pump : Complex raw water requirement is met by water supplied from angareshwar pump house. Unit is receiving this water in reservoir at a pressure of 1.1-1.2 kg/ cm2g.From this reservoir it is pumped to stilling chamber for further treatment. In this scheme unit has taken this water directly to stilling chamber which enables the stopping of raw water reservoir pump. In angareshwar, pumps are running for 16 hrs/ day hence for 16 hrs raw water reservoir pumps is stopped.

Annual power saved : 6.57 lakhs kWh
Total saving Rs lacs / annum : 23.9
Investment Made : Negligible
Payback period : Immediate

7. Excess Process steam from 5th effect evaporator is used in VAR machine in EO-EG Plant.

During the engineering stage of expansion of EO-EG plant to 157% capacity it was noticed that excess process steam will be available (with 0.3 wt% MEG at a pressure of 1.2 kg/cm2 g). Interaction with vapour absorbtion refrigeration unit vendor for MOC suitable for process steam.

Equivalent naphtha saved/ annum : 2420 MT
Total saving Rs lacs / annum : 436
Investment Made : Negligible
Payback period : Immediate

8. Use of waste steam from CPP-2 to VAR of PVC plant :

In CPP-2 excess low pressure steam is being vented, water balance across the plant done and came to know that 13-15 T/ hr steam is being wasted in winter season, as in winter chilling requirement is low hence low steam consumption. To utilize this steam 2 number of 1000 TR each VAR is installed and hence VC machines is stopped.

Equivalent naphtha saved/ annum : 3578 MT
Total saving Rs lacs / annum : 767
Investment Made : 971
Payback period : 15

Energy Conservation Plans and Targets

Energy Conservation Measures (Planned)	Expected Saving Rs lakhs/ annum	Investment Rs lakhs/ annum
Utilization of Natural Gas in CPP-1	10700	Negligible
Modification to utilize Gas in LM 6K GTs and HRSGs in CPP-II.	18300	4000
Low pressure cooling water pumps for PVC plant VAR.	41	20
Thermal Insulation survey of entire complex	25	5
Compressed air system efficiency enhancement.	95	Negligible
Feasibility Study of Waste heat recovery from boiler blow down.	37	15
Training of non supervisor cadre on Energy Conservation	culture building	Negligible

Second Prize ***Petrochemicals***

HALDIA PETROCHEMICALS LIMITED
Haldia (West Bengal)

Unit Profile

The 1052-acre petrochemical manufacturing site of Haldia Petrochemicals Limited (HPL) is located 110 kms south of Kolkata metro in the State of West Bengal on the bank of Haldi river. The site provides an easy access for bringing raw materials & dispatching finished product through river & sea as well as NH41 and lies in the hub of consumer intensive eastern region.

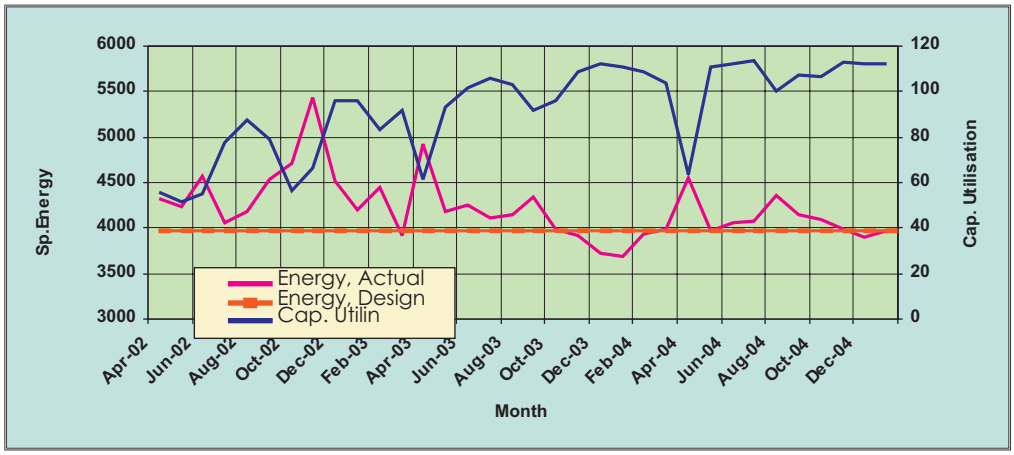
HPL, a multi-product, fully integrated complex & producer of polyethylene / polypropylene plastics, liquid petrochemicals, & automotive fuels is the only such petrochemical manufacturer of eastern India.

Energy Consumption

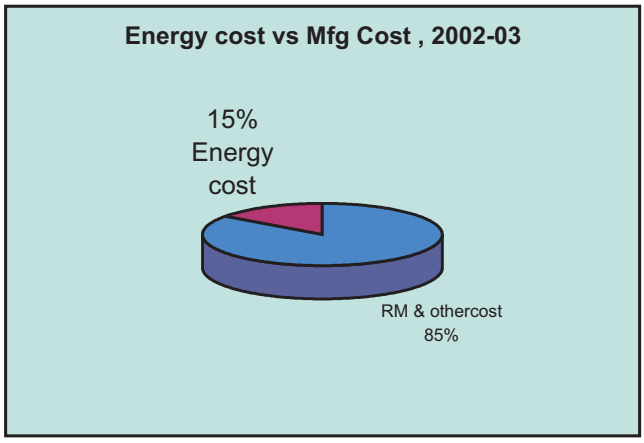
Drooping trend of energy consumption is the result of energy conservation efforts put-forth by HPL right from its inception. Data for the past four years is mentioned below.

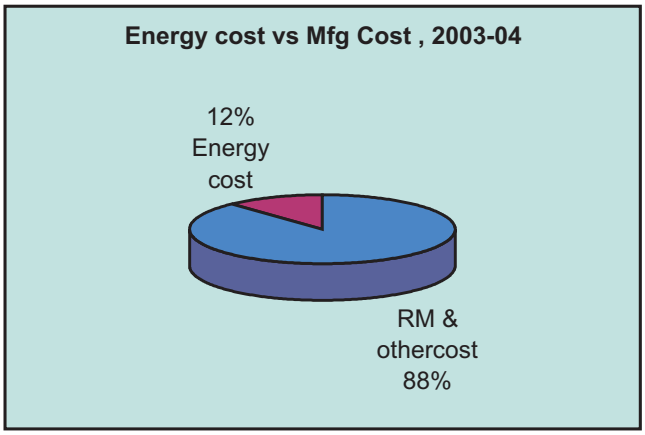
Year (April-March)	Production (In Tons)	Electrical Energy KWH million	Thermal energy (K Cal)
2001 - 2002	HDPE:202080	65.3	91988
	LLDPE:156446	89.0	43201
	PP:145682	22.8	45815
	Benzene:71600	1.07	54194
	Butadiene:13800	10.1	44657
2002 - 2003	HDPE:202150	65.1	82601
	LLDPE:182380	89.7	47577
	PP:191800	49.2	57581
	Benzene:69000	1.09	55294
	Butadiene:17600	12.2	69981
2003 - 2004	HDPE:237442	73.8	94130
	LLDPE:270370	109	62833
	PP:256098	60.5	65770
	Benzene:93000	1.09	68791
	Butadiene:58000	14.0	107167
2004 - 2005	HDPE:263592	78.2	110633
	LLDPE:288810	102.0	69784
	PP:255262	60.3	64001
	Benzene:117730	1.08	84199
	Butadiene:68823	19.77	114005

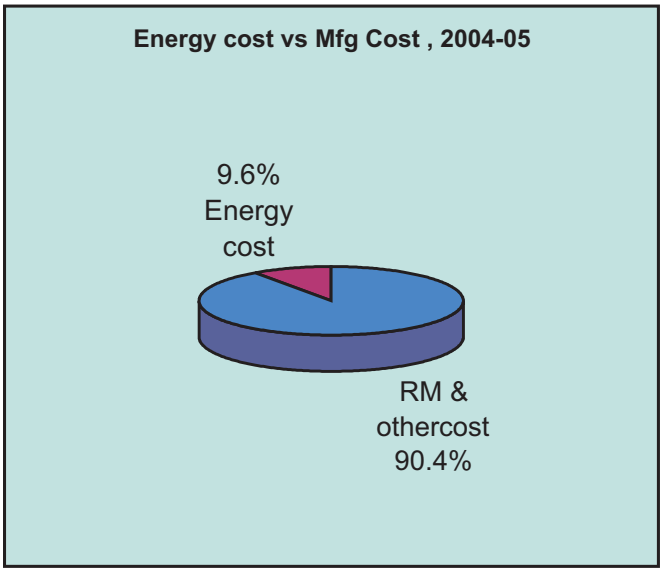
Graphical Representation of Specific Energy Consumption(Mkcal/MT)



Graphical Representation of Energy cost Vs Manufacturing cost





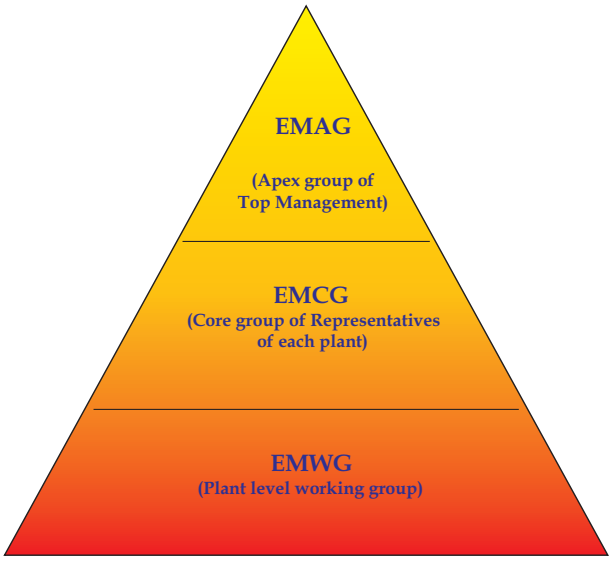


Energy Management Policy

Haldia Petrochemicals Limited is committed to superior energy management by adopting best practices through continuous improvement of knowledge, skills, processes and involvement of all employees and concerned business associates.

Energy Management Set up

HPL has three-tier energy management cell



Energy Conservation Achievements

Major Energy Conservation Schemes implemented

1. Using of nitrogen instead of fuel gas (FG) as sweeping gas for flare header Our original design was using of FG as the sweeping gas in the flare header.

Original design consumptions of FG as sweeping gas were
Sphere area: 300 kg/hr
Loading gantry area: 30 kg/hr
PP plant area: 75 kg/hr
Flare stack: 600kg/hr
i.e. total 1005 kg/hr of FG i.e. 8000 T per year of FG was suppose to be flared. By using of nitrogen as sweeping gas for flare header we are avoiding this flaring of FG. Thus saving of 12000 x 8000 x 1000 i.e.96000 MM Kcal energy in terms of FG.

2. Butadiene dispatch through jetty pipeline

Basis: 4000 T/month dispatch to Kandla as there is no ship loading facility for
Butadiene at Haldia i.e 220 tankers /month
Haldia to Kandla (to & fro of dedicated tankers): 2500 X 2 =5000 km
Fuel consumption: 6km/lit of diesel
Diesel consumption per tanker: 5000/6=830 lit

Total anual diesel consumption will be 220 x 830 x 12 = 2191200 lit= 1862520 kg = 1862 T

To avoid this road transport, HPL had put up a dedicated pipeline from HPL to Haldia Oil Jetty & started dispatches butadiene from Haldia directly. This saves 1862 T HSD on yearly basis i.e. saving of 1862 x 10500 x 1000 = 19500 MM- Kcal of energy in terms of HSD.

3. Cooling Tower (CT-I)fans design changed

The original design of 8 blades FRP blade fans (9 No.s) had been replaced with 6 blades aerodynamically designed fans by which the consumption of electricity had been reduced from 85 KWH/Hr to 54 KWH/Hr per fan. Thus annual reduction of energy consumption of 223 MWH for 9 fans.

4. Butadiene chiller modification

Butadiene is subject to oxidation & polymerization with increased temperature. Butadiene is therefore cooled in storage to maintain a temperature of 8-5°c in sphere. For this, butadiene refrigeration system is provided to maintain the storage temperature & to offset any heat pick up during circulation in the pipeline. The system was put in to operation during commissioning in late 2000; since commissioning several problems have been encountered resulting poor chilling, thus higher run-hours of the compressor.

Problem encountered:

During the operation it has been noted that large quantity of liquid propylene getting accumulated in the Knock Out Drum (KOD) (being carried out from butadiene chiller) at full load of the compressor & even at the 50% loading of the compressor. Liquid level rapidly builds up in the KOD & the compressor got tripped at high level in KOD. To maintain the suction pressure, the pressure control valve got fully opened to put hot vapor in the KOD. Thus the full energy of the compressor is not utilized. To avoid liquid carry over from the chiller, minimum liquid level was maintained in the chiller. Thus most of the Butadiene tube bundles are not immersed in the liquid propylene. So chilling effect on Butadiene was nominal resulted continuous running of the compressor against the 16 hr running & 8 hr.s recession philosophy. Temperature across the chiller in butadiene was only 3°c against the design of 5°c. The problem could not be solved even after communication with the designer for several times.

Root cause analysis:

For proper disengagement of vapor from liquid internationally established design literature says, “The distance from the centerline of the uppermost tube in a horizontal bundle to the top of the shell should not be less than 40% of the kettle dia.” In our case this space was found to be only 28 % of the kettle dia. At the same time it was also found that the chiller does not have any demister to eliminate the liquid mist to carry over.

These design defects were found to be the root causes of the problem.

Proposed changes/modifications:

It was proposed to provide a disengagement vessel (with built in demister) in between the chiller & the Suction KOD. The height of the vessel would be 300mm, which would act as the additional disengagement space. As the vessel would be with the demister this will eliminate the possibility of any further liquid carry over to KOD. The vessel will have 1:15 slope so that the disengaged liquid will be drained down to the chiller.

Benefit observed after modification:

- No liquid carry over observed in the KOD.
- Butadiene differential temperature across the chiller improved from 3°c to 6.5°c.
- Compressor running hours reduced to ~ 6 hr/day i.e. the about 10 hrs reduction of 250KW motor running on daily basis.
- Suction pressure control valve opening almost nil thus full compressor loads is being utilized.

5. Mist Cooling System

Haldia Petrochemicals Limited had adopted a unique new concept of cooling tower named Mist Cooling System of 12000 m3/hr for its revamp, which do not require any fan. A similar capacity conventional cooling tower would have been call for 4 no.s 90 KWH motor running for 8000 hr. Thus it saves energy 8000 x 4 x 90 = 2.8 MMKcal on annual basis.

Mist Cooling Pond & Spray nozzle.

6. Part replacement of naphtha with excess fuel gas in captive power plant

In HPL plant initially, as per the original plant design, there was no provision for utilizing excess raw Fuel Gas (RFG) in the emergency stand by Auxiliary Boiler (AB) of Captive Power Plant (CPP). It was initially a difficult proposition for the power plant to partially substitute naphtha (main fuel for power plant) by consuming the excess RFG generated in house in AB due to the unreliability and variability of its supply. Also this partial replacement of naphtha by FG was subjected to technical plant modifications.

However, considering the clean environmental development & non-realization of the LHV of excess RFG, HPL has taken up this project by ensuring raw Fuel Gas supply to CPP by the following process modification: In case there is any shortfall in the supply of FG, Propylene vapour from propylene sphere is sent to maintain the fuel gas header pressure for half an hour to aid a smooth change over from RFG to liquid fuel. This is helping to maintain the uninterrupted supply of RFG to AB during the station black out situation. The project case includes the following technical modifications:

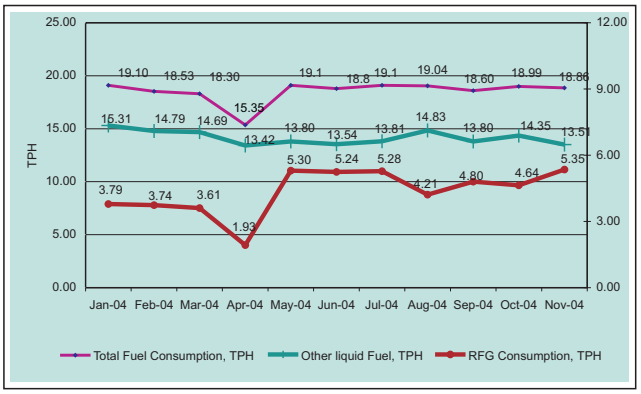
A new pressure control valve has been installed in the Propylene sphere BOG line, the down stream of which has been joined with the RFG distribution network so that whenever there is a short fall in the RFG header pressure, the newly installed control valve will open & Propylene BOG will let down in to RFG header.

After this modification, during normal operation the emergency stand-by boiler ie. AB is on 100% RFG. During Station Blackout (SBO), RFG header pressure is being maintained by automatic let down of propylene vapor from sphere and keep on supplying about 8-9 TPH of RFG for CPP for a short period of about 30 minutes.

By reducing the consumption of naphtha through its partial substitution with excess RFG (which is otherwise flared) this project positively contributes to the diminishment of the total CO2 emission from the plant as well as utilization of LHV of excess FG & lowering of consumption of main liquid fuel, i.e. naphtha.

This modification was implemented in April'04 annual shut down. The attached trend curve shows the reduction of Liquid fuel (Naphtha) consumption in power plant from avg.14.9 T per hour before implementation to 13.5 T per hour & increase of RFG consumption from avg. 3.7 T per hour to 5.35 T per hour.

Raw Fuel Gas(RFG) Utilization in CPP



7. Steam saving in side reboiler in depropaniser tower of NCU

Depropanizer tower separates C3 and C4+ components and the depropanizer system employs two towers- Depropanizer 1(DP1) and Depropanizer 2 (DP2). DP1 and DP2 both distillation towers are having two reboilers. One is bottom steam reboiler where satd LP steam is used and other one is side reboiler where circulating quench water is used as heating medium. To recover low level heat from quench water and reducing steam consumption in main reboilers in both towers, side reboilers heat load are maximized and substantial steam saving is done in both towers. With this modification both towers operations are found normal. 8366 T/ Annum LP steam had been saved.

SIDE REBOILER in NCU

8. Steam Saving due to DP2 feed cooler CW throttling

The Depropanizer system employs two towers (Depropanizer 1and Depropanizer 2) for separation of C3's and C4+ components. Depropanizer 1(DP1) is receiving feed from De-ethaniser bottom and Depropanizer 2 (DP2) is receiving two feeds; one is from DP1 bottom and another is from condensate stripper bottom. Feed from condensate stripper bottom is cooled by CW exchanger(2E-321) before sending it to DP2. By throttling CW supply to cooler, feed temperature is increased from 40 deg C to 55 deg C and tower operation is found stable and normal. Steam comsumption in reboiler is reduced by 0.5 t/hr.

2E-321 in NCU

9. 2K-300 power saving due to higher suction pressure

Cracked gas from heater area is compressed from 0.2268 kg/cm2g to 37.35 kg/cm2g in CG compressor (2K-300). SHP steam is used as motive steam to drive CG compressor turbine (2KST-300). Presently, we are operating CGC compressor at suction pressure of 0.55 kg/cm2g instead of 0.2268 kg/cm2g. Since suction pressure is on higher side and discharge pressure remains same, compression ratio for 5 stages will be less than design. Therefore, power consumption is less than design for compression of the same amount of gas and accordingly, steam consumption in 2KST-300 is less than design. The following calculation is done based on plant load @ 540 KTA. Total power saving is 16011771 KWH/annum due to high CG compressor suction pressure.

Cracked Gas Compressor

10. Power saving Due to low running hours of Decoke Compressor (2K-210)

Naphtha cracker Unit at Haldia Petrochemicals Ltd is having 6 liquid naphtha cracking heaters and one recycle heater for cracking of ethane and propane generated in Naphtha Cracker Unit. After few days of heater operation, coke gets deposited inside cracking coils and to remove this coke, decoking is done using steam and air at high temperature. One decoke air compressor is provided in Naphtha Cracker Unit to supply decoke air when decoking of heater coils is there. During decoking of any heaters decoke air compressor is run for 8 hrs instead of 16 hrs for liquid heaters and for 16 hrs instead of 32 hrs in case of recycle heater. Decoke air for the first 8 hrs is received from IOP for liquid heaters decoking. For recycle heaters decoking decoke air for first 16 hrs is received from IOP. At IOP side no extra compressor is required to be run for this. Thus, 8 hrs power for 2K-210 compressor is saved for every decoke cycle for liquid heaters and 16 hrs power is saved in case of recycle heater decoking. Total power saving for this modification is 836941 KWH/annum.

Decoke Air compressor

Energy Conservation Plans and Targets

The Target set for year 2005-06 by the company is -

- Reduction in specific power consumption by 1.5% minimum by March 2006

- Reduction in steam specific consumption by 1.5% minimum by March 2006.

Environment and Safety

HPL employs proven technologies from world-class licensers to ensure minimum quantity of waste generation, low emissions and low noise pollution. Rainwater harvesting is another area of conservation of resources, which we had already started in last FY. HPL was the first petrochemical complex in Eastern India to be awarded ISO 14001 certification & OSHAS 18000 for an entire and continual improvement in the environment performance. HPL seeks to make all its plants safe places to work, to protect the interests of employees and stakeholders. Safety overrides production targets at HPL. It has its own fire brigade to respond within seconds to any incident of fire. World-class occupational health surveillance systems with periodical health monitoring confirming to OSHA standards are practiced for prevention of work related health hazards.

RELIANCE INDUSTRIES LIMITED
Hazira Manufacturing Division, Surat (Gujarat)

Unit Profile

In a short span of two decades, Reliance Industries Limited has grown from a small scale trading company to the number one private sector company in the country. Just two decades of operation is too small a period for any company to set records in corporate history.

In 1977, it was a small company with sales of Rs. 67 crores , net profit of Rs. 3 crores, and net worth of Rs. 10 crores. Now after 29 years, for the year ending March 2005, Reliance has recorded a gross turnover of 73,164 crores , export of Rs. 25,532 crores and made a net profit of Rs. 7,572 (US$ 1,731 million) crores. The company's total assets are valued at **Rs. 80,586 crores** and the number of shareholders is over 2.2 million . It is the first private sector company in India to record a net profit of US Dollar over one Billion. Reliance is amongst top 10 producers globally of all its major products.

Reliance makes and markets textiles, polyester fibre, plastics, petrochemicals and oil and gas. The company's vision is to "**Create value for the nation by offering competitive goods and services in the materials and energy value chains and infrastructure facilities**."

The 1000-acre Hazira manufacturing site is located 22 kms west of Surat City in the State of Gujarat on the estuary of Tapi river. The site provides an easy access for bringing raw materials through sea and lies in the center of the consumer intensive western region.

Reliance, Hazira a multi-product, fully integrated complex make plastics, petrochemicals, fibre and fibre intermediates

Manufacturing Facilities at Hazira

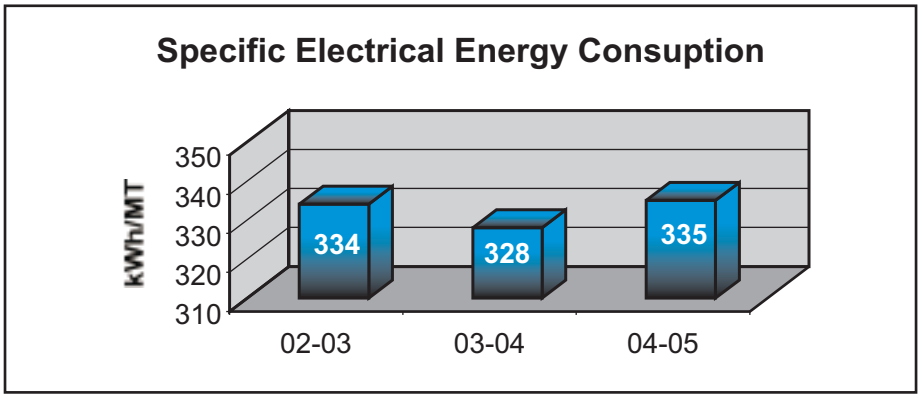
Naphtha is cracked at high temperature to produce ethylene and propylene. Benzene and toluene are extracted from the cracked products. Ethylene is polymerized to LLDPE/HDPE in the polyethylene plant. Propylene is polymerized to PP in the polypropylene plant. Ethylene is chlorinated to ethylene-di-chloride, which is cracked to vinyl chloride and, in turn, polymerized to PVC in the PVC plant. Ethylene is oxidized to ethylene oxide, which is hydrolyzed to MEG in the Mono Ethylene Glycol plant. Paraxylene is oxidized to produce PTA. MEG and PTA are reacted in polycondensation lines to make POY, PSF, Polyester Fibre Fill and PET. The complex has 250 MW of captive power generation capacity based on gas and naphtha. Hazira has its own jetties and a single buoy mooring five km. off the coast for the large tankers to transfer the main raw materials Naphtha and Paraxylene directly to the tank farms. The Hazira complex uses advanced process control systems and the complex operates on a Computer Integrated Manufacturing (CIM) system. Planning the database for the business decision is governed by the vision to use the world class ERP-SAP system uniformly across the

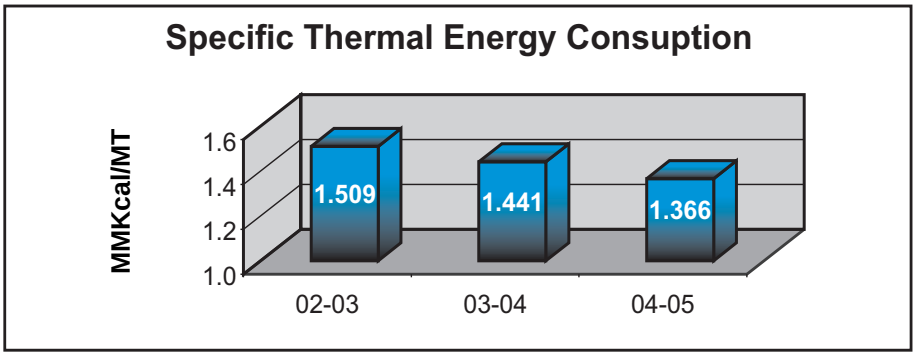
reliance for capturing the data at source, for availability of information online, real time to the users for data security and for smooth data transfer interfaces. Hazira Manufacturing process is supported by process control system by ABB, Siemens .Advance process control, real time optimizer and IP-21 (Info plus) systems allow plant operating data access from any where in the world.

Energy Consumption

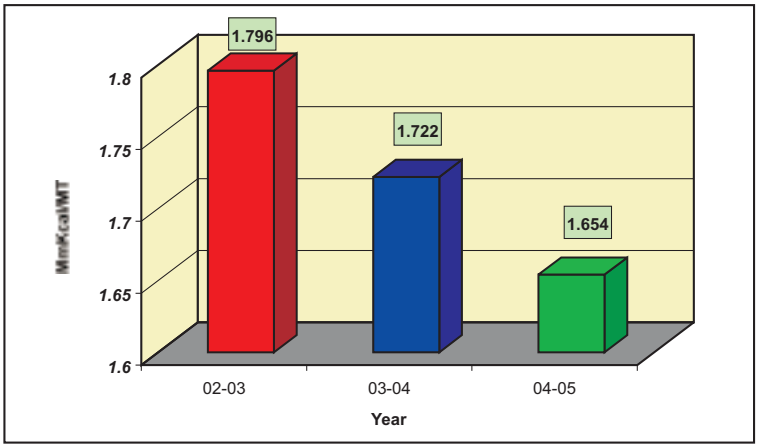
Drooping trend of energy consumption is the result of energy conservation efforts put-forth by RIL Hazira team . Data for the past three years is mentioned in the table:

Description	Unit	Year		
		2002-03	2003-04	2004-05
Annual Production	MT	5161629	5387547	5585260
Electrical Energy Consumption	Lakh kWh	17242	17651	18710
Thermal Energy Consumption	Mmkcal	7789020	7761962	7627549
Specific Electrical energy consumption	kWh/MT	334	328	335
Specific Thermal Energy Consumption	M kcal/MT	1.509	1.441	1.366
Overall Specific Energy Consumption	Mkcal/MT	1.796	1.722	1.654
Energy Cost/ Manufacturing Cost	%	3.4	4.48	3.31





Overall Thermal and Electrical Energy Consumption



The above specific consumption figures will improve further because of

(i) Various Energy Saving Schemes which are in the process of implementation.

Energy Conservation Commitment, Policy & Set-up

* To intensify the in-house efforts for improving Energy Efficiency separate Energy Cell was created by the management.

* The Energy Cell is operational since June '99 under the guidance of Sr. Vice President, Energy & Fuel Cell.

Four Tier Energy Management System is followed at Hazira

* The **Apex Group** comprises of primarily the top management at RIL Hazira. The Executive Director (Hazira Site) heads this group.

* Energy Cell is headed by Vice president. He has 4 engineers working with him. This is the **Core** Group.

* Each of the plants has a designated Energy Co-coordinator. The Energy coordinator of Individual plant along with a technical service engineer and a electrical engineer of the same plant forms the **Working Group.**

* **Small Group Activity** is the new initiative to involve shop floor people in the energy conservation. All the plants have nominated members for the SGA and the training for the group was organized through Confederation of Indian Industries. The groups have started regular meetings for brainstorming and developing ideas in their working area based on quality circle philosophy.

The major functions of the four tier groups

Groups	Organization	Functions
Apex Group	• Executive Director – RIL, Hz • President – Manufacturing • Vice President – E & FC • Vice President – CTS/TS • AVP – CPP & U • AVP – Polymer, • GM – Fiber • GM – MEG, • GM - Electrical	> Review complex energy consumption trend. > Review status of schemes. > Major decision making for implementation & continued improvements
Core Group	• Vice President – E & FC • Engineers – E & FC	> Compile energy schemes. > Prioritize the schemes > Review and add values to the schemes. > Arrange for external audit > Provide guidelines to working group. > Arrange for training. > MIS reporting. • **Additional:-** > Economic optimization of various fuels. > Substitution of costly fuels by technically suitable cheaper fuels. > Optimise Power / Utilities operation and reduction in unit cost of steam / power / utilities generated. > Reduction in total demand by user plants for power and utilities.
Working Group	• **Plant Energy coordinators** • Plant CTS/TS Engineers • Plant Electrical engineers	> Create Data Base > Monitor efficiencies > Audit > Conceive new schemes > Implement approved schemes
Small Group	• Leader and Non-supervisory staff from process, electrical and mechanical	> Brain storming. > Identification of theme on energy conservation. > Study the system w.r.t. energy. > Implementation of energy efficiency projects.

Energy conservation Achievements

Major Energy Conservation Schemes implemented during 2003-04

1. Fractionation scheme with benzene boil first

Fractionation unit in Aromatics plant was designed to operate along with MSTDP unit to convert Toluene in to Benzene and para rich Xylene. The separation of these component is done through 2 nos. distilation colum cascaded in serise which first seperates para rich xylene as bottom product from the feed containing about 50% Benzene. The next column sepeares Benzene as top product and Toluene as bottom product. Thus, original fractionation scheme for separating Benzene, which was major component having around 50 % concentration in feed, was getting boiled twice.

In case Benzene is separated first then substantial energy saving could be achieved on acount of reduced steam consumption in the reboilers. The feasibility of interchanging of existing distillation columns with minimum modifications checked. It was observed on through process simulation that the existing columns are suitable for revised service.

A field change order was made and detailing of the scheme was carried out. Project was taken on fast track basis and executed as designed. It was observed the there was no compromise with quality of products e.g. Benzene, Toluene and Xylene. The scehme resulted in the saving of 5 TPH of steam. MP steam. Thus total savings of Rs. 200 lacs per annum was achieved at an expenses of Rs. 5 lakhs. The scheme is unique in its kind having potencial to become a trend settler in the industry of simmilar nature.

2. Make up water heater in BHEL HRSG

At RIL Hazira, from Gas Turbines exhaust gases, high pressure steam is generated through Heat Recovery Steam Generator (HRSG). In BHEL HRSG's the stack temperature used to remain around 200°C. The dew point temperature of the flue gases was calculated based on the liquid fuel firing and found out to be 130°C. Therefor it was found that the stack temperature can be safely brought down to 145°C safely. Hence it is decided based on cost-benefit analysis to utilise this residual energy for preheating the boiler feed water routed to De-aerator.

Make up water Heater in BHEL HRSG - CPP

The scheme was implemented in one HRSG for trial and substantial saving of Rs 5.35 crores/annum could be achieved with an investment of Rs 2.06 Crores. For remaining 4 HRSG's make up water heater procurement is in progress.

3. Ethylene tower vapor feed directly to VCM plant.

This scheme takes out direct vapor product from the distillation column instead of liquid. By this mode the vapor product condensation to liquid product is not there,hence the duty on distillation column condenser is reduced as now it need not condense product. With this the condenser got offloaded & the propylene refrigeration duty also got reduced & the propylene refrigeration compressor got offloaded. The steam saving realized in propylene refrigeration compressor steam turbine driver was ~ 2 MT/hr SHP steam.

The investment for the modification is 125 lakhs and the saving realized is Rs 221 lakhs/annum. Simple payback of the scheme is 6.8 Months

Ethylene Tower Vapor Feed To VCM

4. Use of Hot recycle solvent to preheat reactor feed in PE-II plant

Polyethylene production in PE-2 plant is carried out by polymerisation of ethylene at 160 kg/cm^2 pressure and 250 ^{o}C temperature in an adiabatic reactor. This is a Solution Polymerisation process which uses Cyclohexane as the solvent which converts monomer (Ethylene) and comonomer (Butene) to polyethylene.

Process - Process Exchanger - PE Plant

The recycle Cyclohexane coming from reflux drum after purification to reaction area is at 160^{o}C. It is cooled to 28^{o}C by cooling water in recycle coolers. It is further cooled to 20^{o}C in chilled water exchanger. The total heat is lost in cooling water.

A Process- Process heat exchanger is installed in parallel to the existing reactor feed heater in the bypass line to conserve MP steam in reactor feed heater. The recycle Cyclohexane which was loosing the residual heat in cooling water is now used to preheat the reactor feed before going to cooling water. Suitable instrument system has been designed to control the reactor feed temperature.

The saving achieved was Rs 397 lakhs/annum with an investment of Rs:32 lakhs. The simple payback is 1 Month.

5. APH modification from co-current to counter current (AX / BX)

In Dowtherm Vaporiser - Air Pre Heater (APH) combustion air is heated prior to feeding in the vaporiser by the residual heat of flue gases. The preheater was designed for co-current flow directions. The analysis through process simulation revealed that counter current flow direction is likely to enhance the heat transfer efficiency. By siutably changing the combustion air duct, flow direction was changed to counter current therby reducing fuel gas consumption by 11 Nm3/hr worht Rs. 7.5 lakhs p.a. at the expence of Rs. 0.8 lakhs (Simple pay back : 9.4 months) per vaporiser.

The scheme was implented for 2 nos. vaporiser during Sept '04 and Oct '04.

6. Optimization of Slurry mole Ratios in all Esterification areas to reduce heat loads

The esterification reaction of polyester plants is designed to operate at atmospheric pressure. To achieve complete conversion of all MEG and PTA to oligomer, excess MEG is used in the rawmaterial mix. The excess MEG is vaporised in the estrefication process which in turn condensed. By using a lower mole ratio, the quantity of excess MEG was reduced thereby reducing the amount of heat used for vaporization the excess MEG.

Total saving of Rs 29.4 lakhs/annum could be achieved without investment.

7. Preheating of heads column feed using High boil product stream.

In VCM plant, crude EDC produced from Oxy reactor contains lighter components such as ethyl chloride, chloroform, carbon tetrachloride etc. These are separated in Heads Column – I. The light components are required to be removed from EDC as these are coker for EDC cracking furnaces.

In Hiboil column product EDC is withdrawn from 35th tray of the column at about 90^{o}C. Hot EDC is cooled by cooling water in Hiboil column product coolers EA-6310 A/B/C/D and stored in Furnace feed tanks at ambient temperature. In this process the heat is lost to cooing water.

It is proposed to recover heat from Hiboil column product by preheating feed to Heads column–I using a shell and tube heat exchanger. Hot feed from this exchanger will be fed to Heads column. This has resulted in the savings of 0.5 TPH MP steam which is equivalent to Rs. 33.1 lakhs per annum at an investment of Rs. 13.75 lakhs.

8. Optimization of feed tray location in Hiboil column.

In VCM plant, Hiboil Column is used to remove heavy chlorinated hydrocarbon impurities from EDC and purify EDC to the required quality for feeding to EDC cracking furnaces. Hiboil column is having 40 superfrac trays and packed bed of 5 m height with 2” pall ring packing. Following three different feed streams are fed to Hiboil column for further purification.

1. Heads column – I bottom stream at 8th tray
2. Heads column – II bottom stream at 8th tray
3. VCM Column bottom stream at 16th tray

Product withdrawal is from top tray and stream containing heavies is removed from column bottom. Column is operating with top pressure of ~ 0.2 kg/cm^2 g and reflux ratio is in the range of 0.8-0.9. Column reboiler uses LP Steam at the rate of 32-34 TPH.

It is recommended to change the feed location of Heads column II bottom stream in Hiboil column as follows:

a. When TCA content in Heads column II bottom stream is less than 100 ppm divert it to reflux stream.

b. When TCA content in Heads column II bottom stream is more than 100 ppm feed it at tray no. 32

Average reduction in LP steam consumption by 4 TPHis achieved which is equal to Rs. 265 lakhs per annum.

Energy Conservation Plans and Targets

The Target set for year 2005-06 by the company is -

* Reduction in power consumption by **1.5% minimum** by March 2006
* Reduction in steam consumption by **1.0% minimum** by March 2006

Major Energy Conservation Schemes Planned for F.Y. 2005-2006

Sr. No.	Energy conservation Measures (Planned)	Anticipated Savings per year		Approximate Investment (Rs. Lakhs)	Project commencement & completion year
		Energy Value (Mmkcal)	Rs. Lakhs		
1	C3R compressor steam reduction by cold recovery from de-methaniser, pre-stipper column	6539	40.2	76	05-06 06-07
2	Dilution steam generator blowdown to be reduced by 17 m3/hr by using a exchanger	16801	103.2	20	05-06 06-07
3	Cracker fuel gas compressor suction pressure drop reduction	4541	38.4	13	05-06 06-07
4	Use of MSTDP de-tol tower in place of extract de-tol tower	23181	194.7	-	05-06 05-06
5	Optimisation in effluent pump in PVC	204	5.4	2	05-06 05-06
6	Generation of LP steam from HP condensate	7720	59.1	6	05-06 05-06
7	Stopping of SHP let down to 22k for HRSG 5/6/7	5231	32.1	8	05-06 05-06
8	Reduction in GT – 1 and 2 back pressure by imporved chemical c leaning	7193	44.2	0	04-05 05-06
10	Reudction in plant and instrument air header pressure	1688	44.4	20	05-06 05-06
11	Installation of balance make-up water heater in HRSGs	108074	663.7	439	04-05 05-06
12	Stopping of one VGR compressor during HOMO grade in Polypropylyne plant	5879	154.42	0	05-06 05-06
13	Chilled water cold tank by-passing in POY plant	3015	52.5	65	05-06 05-06
14	Automatic change over from Delta to Star for 75 kw motor in baler	93	2.44	0	05-06 05-06
	SUB TOTAL	**190158**	**1434.76**	**649**	

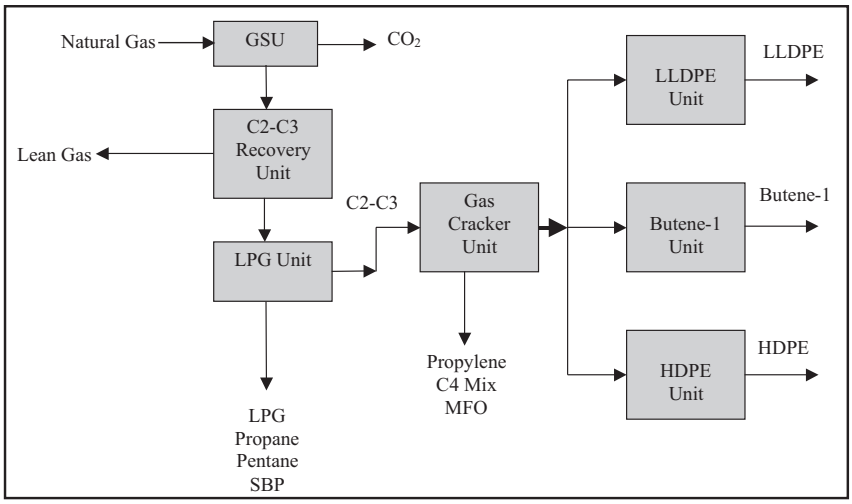
Sr. No.	Energy conservation Measures (Planned)	Anticipated Savings per year		Approximate Investment (Rs. Lakhs)	Project commencement & completion year
		Energy Value (Mmkcal)	Rs. Lakhs		
15	Fuel gas export header globe valve to be replaced by a gate valve	1112	10	0.15	05-06 06-07
16	Brian – I pump and motor replacement with higher size for energy saving	117	3.07	3.5	05-06 05-06
17	Replacement of SHP steam by HP steam in PE plant steam purge heater and cyclohexane make-up dryer	2838	19.2	0.2	05-06 05-06
18	Heat recovery from purification vent scrubber to geenrate LP steam	3088	15	TBQ	05-06 05-06
19	Reduction in stack temperature of POY dowtherm vaporisers and reuction in emission	11700	80	TBQ	05-06 06-07
20	Air pre-heater of DTA vaprisers to be converted from co-current to counter current	432	7.5	2	05-06 05-06
21	Replacement of SHP steam with 17 barg steam & generation of flash steam from HP condensate	31423	160	80	05-06 05-06
	SUB TOTAL	**50710**	**295.24**	**86**	
	TOTAL	**240868**	**1730**	**735**	

GAIL (INDIA) LIMITED
Pata, Auraiya (Uttar Pradesh)

Unit Profile

GAIL, Pata is a wholly owned unit of GAIL (India) Limited. It is geographically located in between Kanpur and Etawah by the main railway line from Kanpur to Delhi. This complex is a grass-root, energy intensive, integrated gas based Petrochemical Plant having end product as Polymer (comprises of HDPE & LLDPE), Liquefied Petroleum gas and Propane etc. The sales turnover of this complex is Rs. 2305 crores in the year of 2004-2005.

Gail, Pata works with a global focus to create and strengthen significant global presence to pursue strategic, attractive opportunities that leverage company's capabilities while effectively manages business risk. Our mission is to accelerate and optimize the effective & economic use of natural gas and its fractions to the benefit of national economy. This complex has acquired ISO 9000, ISO 14000 and OHSAS 18001 certificates.



Energy Consumption

Year	Prod. MT	Energy Consumption		Specific Energy Consumption	
		Lakhs kWh	MKCals	kWh/ Tonne	MkCal/ Tonne
2002-2003	585,612	2912	4033065	497	6.89
2003-2004	553,305	2607	3730609	471	6.74
2004-2005	594,266	2702	4103518	455	6.91

Above production is considered for Polymer + LPG + Propane

Year	Product	kWh/ Tonne	% reduction over 2002-2003	MkCal/ Tonne	% Reduction over 2002-2003
2002-2003	Polymer+	497	—	6.89	—
2003-2004	LPG+	471	5.23	6.74	2.17
2004-2005	Propane	455	8.5	6.91	-0.29

Energy Conservation commitment, Policy and set up

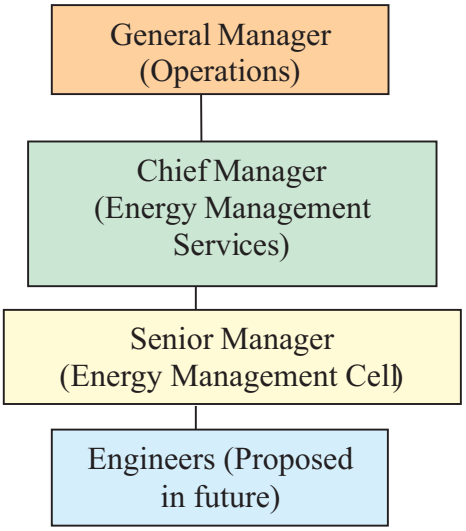
GAIL, Pata is involved in petrochemical sector. It consumes natural gas as raw material. It also has calorific value of its own. Same is with the all the production intermediaries. Apart from that it also requires conventional energy forms like Thermal and Electricity. GAIL, Pata is always endeavoring to lessen specific consumption values. A target is always set regarding this at the beginning of the year itself. Then this target is met with both applying some engineering and also raising the production. The actual specific consumption figure is compared with the target values on weekly basis.

Energy Conservation week is celebrated every year. A poster and slogan competition on energy saving and in-house seminar is conducted. The importance of energy conservation is also emphasized through various forums like Quality circle and TQM.

Energy management Policy

GAIL Pata is committed to efficient and optimal use of energy resources in all its applications and services through effective energy management with focus on productivity, cost effectiveness, environment and a better tomorrow.

Energy conservation Cell structure



Energy Conservation Achievements

1. Energy Audit has been completed during the year and the following recommendations of the energy audit have already been implemented:

Job	savings
Rectification of the IGV of FD Fan used in UB-1	Rs.24 Lakhs/year
Replacement of the defective insulation of pent house of UB-1 & 2	Rs.6.2 Lakhs/year
Reduction in Radiation and Blow down losses of GCU Furnaces	Rs.36 Lakhs/year
Installation of timer circuit in ware house lighting has resulted into savings of electrical energy	Rs.23.2Lakhs/year
Power factor improvement	Rs. 164 Lakhs/year
Rectification of steam leakages and traps	Rs. 970 Lakhs/year
Total	Rs. 1224.5 Lakhs/year

2. **Process Audit of GPU, LPG & IOP&S units:** Process Audit has been carried out for GPU, LPG and Offsite & Utility Units by M/s Technip KT India, Noida during the year. Some of the recommendation of the process Audit has been taken up which have yielded considerable savings. Implementation of the amine reclamation system has resulted in an annual savings to the tune of Rs. 120 Lakhs.

3. **Process Audit of GCU & Butene-1 Plants**: Process Audit of the Butene-1 unit has been carried out by the licensor, M/s Axens, France during September- October 2004. Similarly, Process Audit of Gas Cracker unit (GCU) is undertaken through the licensor, M/s SWEC, USA.

4. Benchmarking exercise for process units to monitor and control of specific energy consumptions.

5. Maximization of internal power generation for the requirements of petrochemical complex. Minimum power import (315 MWH) is achieved during the month of March 2005.

New Technologies introduced in existing operations:

6. Installation of timer circuit in ware house lighting has resulted into savings of electrical energy to the tune of Rs. 23.2 Lakhs.

7. VSDs installed for Low polymer pump and Second slurry cooler pumps of HDPE Plant have resulted into efficient operation as well as yielded operational flexibility.

8. The technology selected for new HDPE plant (expansion project) is capable of producing various other grades (MDPE grades) of polyethylene

The following energy conservation projects have been taken up for implementation during the year:

9. **Flare Gas Recovery Project:** After necessary approvals, 'Flare Gas Recovery Project' has been taken up for implementation. This project envisages recovering the flare gases going through the flare system for ultimate use as fuel gas in the utility boilers. The project consisting of gas compression system and associated piping etc. will be implemented through an EPCM consultant, M/s Lurgi India. The estimated expenditure of the project is Rs. 10.72 Crores. Implementation of the project would result into fuel savings to the tune of Rs. 6.5 Crores per year.

10. **Installation of additional STG**: Installation of a 9 MW extraction type STG is under progress. The setting up of extraction type STG would enable efficient use of the VHP steam to produce HP steam & also in power generation.

11. Installation of VSD to FD Fans of Boilers for reducing power consumption. Expected annual savings is Rs. 34.94 Lakhs

12. **Advance Process Control (APC):** This project is under implementation for upstream units (GPU/ LPG/ GCU units) of Petrochemical project. After implementation, the project is expected to reduce the specific energy consumption to the tune of 3% in these units.

Energy Conservation measures (planned)	Anticipated Saving			Estimated Investment	Simple Payback period	Project Commencement & Completion year
	Quantum (KWh)	Lac K. Cal	Rs. Lakhs	Rs. Lakhs	Months	
Flare Gas Recovery System	154527907	1328940	652	1072	2430	2006-07
Installation of variable frequency drive on the cooling water make up pump	224500	1931	11.22	3.5	3-4	2005-06
Installation of automatic temperature controller on cooling tower fans of CT-1 Replacement of conventional tube lights	64320	553	3.21	0.6	2-3	2005-06
with energy efficiency tube lights	258075	2219	12.9	21	19-20	2005-06
Replacement conventional HPSV, HPMV lamps with low loss electronics ballasts	214600	1846	10.73	28.86	32-33	2005-06
Replacement of PRDS1 with back pressure turbines	15480000	116724	774	300	38082	2005-06
Implementation of Advance Process Control		1231060	610	300	6-8	2006-07

Environment and safety

GAIL, Pata is committed to the protection of the environment by prevention of pollution and continual improvement in the Environmental Performance. The company has successfully installed Environmental management System and got the certification of ISO 14001 in the year of 2002.

The process of implementation was initiated in 2001 during which following efforts were undertaken and on going efforts are continuously on as per the Environmental Policy:

- Minimize generation of waste.
- Conservation of resources.
- Recycling & re-use.

The company, from its incipience, has integrated Effluent Treatment Plant (ETP) and a Sewage Treatment Plant (STP) for wastewater from plants and other means. It is monitored continuously as per UP Pollution Control Board (UPPCB) norms. The company has minimized the wastage of natural resources by use of recycled STP treated water for Gardening.

CASTROL INDIA LIMITED
Patalganga, Raigad (Maharashtra)

Unit Profile

Patalganga Plant of Castrol India Limited, one of the flagship lubricants blending and filling unit is situated at Patalganga Industrial Area, in Raigad District, approx. 60 kms from Mumbai in Maharashtra State. The plant manufactures Automotive and Industrial lubricants, Brake Fluids and Coolants & has a manufacturing capacity of 100,000 kl/annum. The plant produces 40% of automotive lubricants volume of Castrol India and manages the distribution of the same across the country .

This Plant is a part of the global Lubricants Supply Chain business of BP Group, with unique Quality, HSSE and Environmental Policies.

Energy Consumption and Trends from 2001- 2004

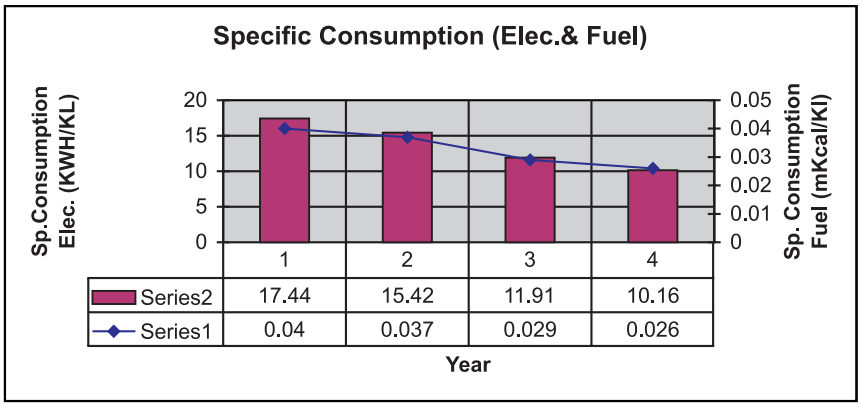
Major focus on energy conservation was initiated since end 2001 & there has been continous & major improvements during the last 3 years , highlights of which is detailed below:

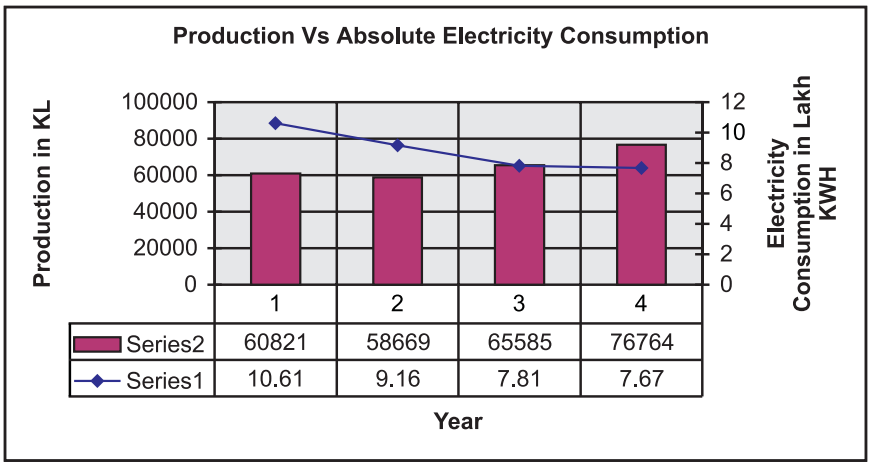
Specific Power Consumption Details	Unit	2001	2002	2003	2004
Annual Production	KL	60821	58669	65585	76764
Absolute Electricity consumption	KWH(Lacs)	10.61	9.16	7.81	7.67
Specific Electricity consumption	KWH/KL	17.44	15.42	11.91	10.16
Specific fuel consumption	Mkcal/kl	0.04	0.037	0.029	0.026
Thermal Fuel consumption	Mkcal	2452.92	2182.67	1879.15	1983.18
Energy cost as % of Manufacturing cost	%	8.3	8.18	7.1	6.7

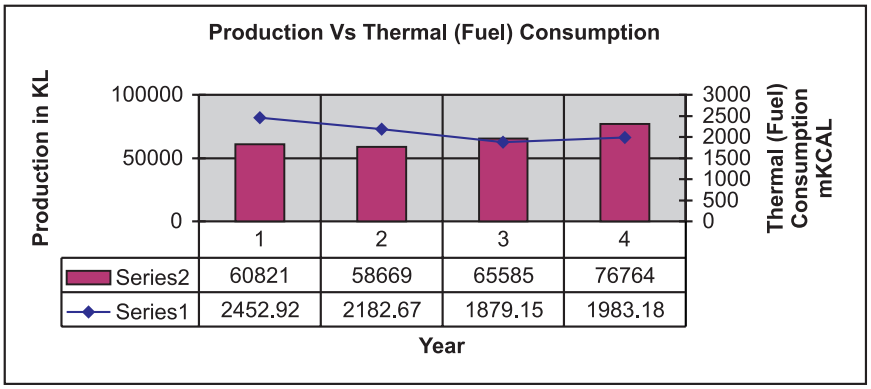
- For 26% increase in Production,
  - # Energy cost reduced by 27%.(from Rs. 78.44 lacs/- to Rs.57.06 lacs/-)
  - # Absolute electricity consumption reduced by 27%
  - # Absolute furnace oil consumption reduced by 19%
- Specific Consumption of electricity reduced by 41%
- Specific Consumption of furnace oil reduced by 36%
- Reduction in CO2 emission level from 0.026 per Ton KL of oil to 0.015 per Ton KL of oil. i.e., reduction of around 42%.

- Reduction in batch cycle time, maintenance cost and higher performance reliability.
- Compliance of environmental management system requirements as committed in Environment Policy.

Energy Conservation Policy, Commitment and Organisational set up







In order to look at ways and means to reduce the energy cost, it was decided to initiate a Small Group Activity in the year 2001 with the following objectives :

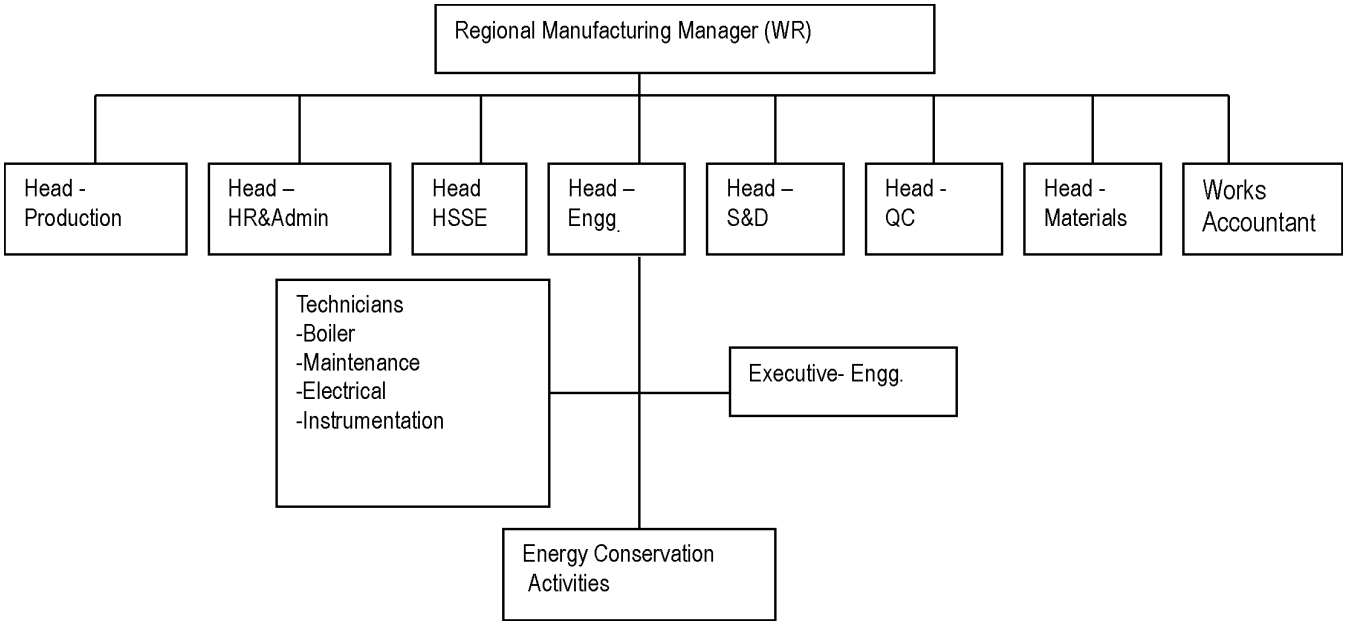
- Minimize energy cost through energy conservation measures.
- Comply with Environmental Management System requirements.
- Initiate continual improvement drive towards energy conservation.
- Improve awareness amongst employees towards energy conservation.
- Maximize capacity utilization by upgrading operational & maintenance standards
- Monitoring for continuous improvement in energy conservation

Organizational Set up-Energy conservation

The unit is headed by the Regional Manufacturing Manager who drives the Energy conservation activities along with the Engineering Manager and the various departmental heads. The improvements and initiatives to be taken are reviewed in the monthly meetings. The organogram of the unit is as under:

Energy Conservation Achievements

The plant has participated and won the National Energy Conservation Awards 2004, Certificate of Merit



in the Petrochemical Sector.

Some of the major projects executed in the year 2004.

1. Solar Hot Water Heating System for Canteen
2. Condensate Pumps for higher recovery of condensate & reduce BCT.
3. Replacement of old pumps by energy efficient pumps.
4. Energy Efficient Tubelights.
5. Modification of condensate transfer lines.
6. Capacitors across motor terminals & transformer.
7. Rationalization of oil transfer lines to reduce losses.
8. Modification of Induction Heat Sealing Machines.

Major Energy Conservation Projects implemented in the year 2004 were

1. **Solar Hot Water Heating System of 1500 LPD & 600 LPD installed at canteen to supply the hot water required for cleaning & cooking.**

A	1500 Ltrs. Capacity for cleaning utensils		
1	System Capacity	1500	Ltrs/Day
2	System Output Temperature	60	deg.Cel.
3	Average Ambient Temperature	25	Deg.Cel.
4	Heat gained per day from the system	48000	Kcals.
5	Heat gained per year assuming 320 sunshine /	12240000	Kcals.
	255 working days in a year. (Min. of two)		
6	Fuel used	Electricity	
7	Calorific Value per Unit	860	Kcals/Kwh
8	Conversion Efficiency	90%	
9	Equivalent Energy saved through Solar	15814	Kwh per Year
10	Cost of Power per Unit.	4	Rs/Kwh
11	Net Cost of Power Saved	63256	Rs.
B	600 Ltrs. Capacity for Process.		
1	System Capacity	600	Ltrs/Day
2	System Output Temperature	60	deg.Cel.
3	Average Ambient Temperature	25	Deg.Cel.
4	Heat gained per day from the system	21000	Kcals.
5	Heat gained per year assuming 320 sunshine/	5355000	Kcals.
	255 working days in a year (Min. of two)		
6	Fuel used	LPG	
7	Calorific Value per Unit	9400	Kcals/Kg.
8	Conversion Efficiency	100%	
9	Equivalent Energy saved through Solar	570	Kgs.
10	Cost of Fuel per Unit.	25	Rs/Kg.
11	Net Cost of Fuel Saved	14250	Rs.
C	Total Savings A + B	77506	
D	Total Investment	305000	Rs.
E	Less : Tax Benefit on Depreciation @30%	91500	Rs.
F	Balance after depreciation	213500	Rs
G	Savings per annum	77506	Rs.
H	Hence, simple Pay Back period will be	3	Years

Solar Hot water heating system

2. Reduced the connected load by 15 HP by conducting motor load survey, replacing old inefficient pumps by new pumps with right capacity motors.

Reduction in Units = 11.25 KW X 200 Working days X 10 Hr.

= **22,500** KWH.

11.25 KW is the net reduction , which is the difference between replacement motor KW minus avg. input power of existing motor.

3. Replacement of 50 Nos. Conventional tube-lights by energy efficient tube-lights.

Electricity consumed by Conventional Tubelights (Watts)	Electricity consumed by energy efficient Tubelights (Watts)	Net Savings per Hr. (Watts)	No. of Tubelights replaced (Nos.)	Total Burning Hrs. per annum	Total Savings (KWH)
54	28	26	50	4064	5568

4. Installation of two nos. condensate pumps for higher recovery of condensate and reduce BCT and condensate return lines modified.

Total Fuel Consumption by four blenders	:	3,000 Kgs / per batch
Reduction in heating time	:	17%
No. of batches per year	:	240
Total savings in steam consumption	:	0.17 X 3,000 X 240
	:	1,22,400 kgs.
Steam Fuel Ratio	:	12:1
Fuel saved per annum	:	10,200 ltrs.

5. Rationalization of Headers & replacement of 1-1/2" hoses by 2-1/2" hoses.

Reduction in total run time of motors through faster transfer of oil & faster loading of tankers	:	1.25 Hrs/day.
Total no. of working days in a year	:	240
Average motive power	:	20 HP
Total Savings in KWH	:	20 HP X 0.75 X 1.25 hrs X 240 days
	:	**4500 KWH**

6. Modification of Induction Heat Sealing Machines from transistor to IGBT.

Reduction in current consumption per machine	:	4 Amps.
No. of machines modified in the year 2004	:	1
Average running hours of the machine per day	:	8 Hrs.
No. of working days per annum	:	240.

Saving in elec. consumption p.a. = 1 M/cs X 4 amps X 230 Volts X 8 Hrs X 240 days
= **2,208 KWH**

Energy Conservation Plans and Targets

The following major Energy Conservation Projects are streamlined for the year 2005.

1. Solar Street Lights.

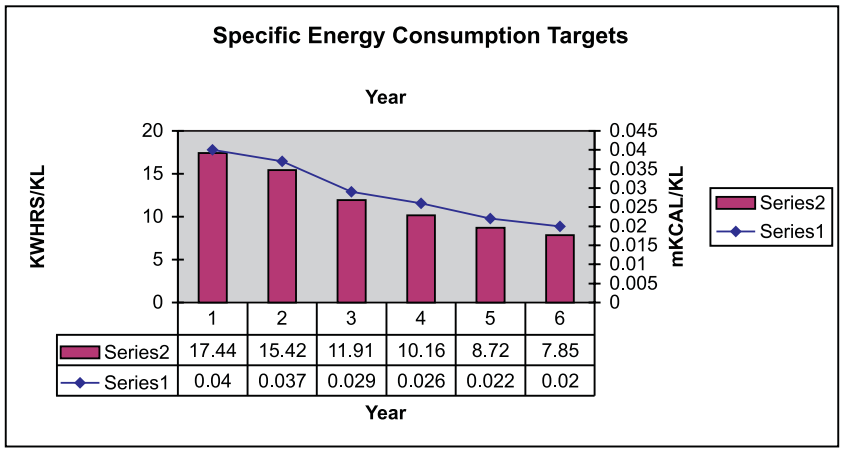
2. Steam Flow-meter.

3. Replacement of conventional tube lights by Energy Efficient tube lights.

4.Replacement of old inefficient pumps by efficient pumps.

5.Efficient heat exchanger for base oil heating for reduction in blend time

The Specific Energy Conservation targets set by the plant for the year 2005 & 2006, are as below.



Environment and Safety

Environmental Policy

Patalganga Plant of Castrol India Limited manufactures world class lubricants undertaking operations of blending, filling, packing and dispatch in a responsible manner so as to cause no harm to environment.

Accordingly, Patalganga Plant is committed to :

- Comply with all relevant legal and other corporate requirements applicable to the environmental aspects of our activities, products and services.
- Continually improve our environmental performance by reducing leakage and spills, hazardous and non hazardous solid waste.
- Prevent pollution, encourage re-use/recycling and use energy and natural resources efficiently.
- Maintain an environmental management system for setting, reviewing and achieving measurable environmental objectives and targets.

Company's major focus towards spill prevention has improved the environmental conditions in plant premises with respect to elimination of soil pollution & reduction in waste oil generation

HSSE Policy

Everybody who works for BP, anywhere, is responsible for getting HSE right. Good HSE performance and the health, safety and security of everyone who works for us are critical to the success of our business.