

BPCL KOCHI REFINERY

(i) Unit Profile

Cochin Refineries Limited was incorporated in the joint sector as a Public Limited Company in September 1963 with technical collaboration and financial participation of Phillips Petroleum Company of USA and Duncan Brothers of Calcutta. The Refinery was commissioned in 1966 with a crude processing capacity of 2.5 Million Metric Tons per Annum (MMTPA). The name of the Company was changed to Kochi Refineries Limited (KRL) in May 2000. The Refinery became a subsidiary of M/s Bharat Petroleum Corporation Limited (BPCL) in March 2001. Pursuant to Order dated 18th August 2006 issued by Ministry of Company Affairs the refinery has been amalgamated with **Bharat Petroleum Corporation to form BPCL Kochi Refinery.**



A night view of our refinery

From the date of commissioning to-date, the refinery undertook three expansions in refining capacity and installation of several new process units and other facilities. Many of the facilities have undergone modernization at various stages. The refining capacity was first expanded from 2.5 to 3.3 MMTPA in September 1973. The production of Liquefied Petroleum Gas (LPG) and Aviation Turbine Fuel (ATF) were commenced after this expansion. The capacity was further increased to 4.5 MMTPA in November 1984 along with the addition of 1.0 MMTPA capacity Fluid Catalytic Cracking (FCC) unit. The crude processing capacity was finally expanded from to 7.5 MMTPA in December 1994, with the installation of a second crude distillation unit and associated facilities. Along with this expansion the

capacity of the secondary processing facilities was enhanced to 1.4 MMTPA. A Fuel Gas Desulphurization Unit was also installed as part of the expansion project as an environmental protection measure, to minimise sulphur dioxide emission from the Refinery.

During the year 1989, the Company commissioned an Aromatics Recovery Unit (ARU) with a design capacity of 87,200 Tonnes Per Annum (TPA) of Benzene and 12,000 TPA of Toluene, marking our refinery's entry into the field of petrochemicals. Distributed Digital Control Systems (DCS) were installed for the process units in the same year.

A Captive Power Plant of 26.3 MW ISO rating was commissioned in March 1991 to meet the power requirements of the refinery and to safeguard the operations against the power supply fluctuations in the State grid. During the year 1998, an additional Captive Power Plant of 17.8 MW capacity was commissioned making the Refinery self-sufficient in power.

Advanced Process Control (APC) technology was first installed in the Crude Distillation Unit – 1 (CDU-1) in March 1992 and subsequently the technology was implemented in FCC unit and CDU-2. The benefits arising out of implementation of APC are increased safety, enhanced yields, increased throughput, **reduced energy consumption**, etc. The continuous monitoring and control by APC permits us to optimize the energy requirements of the process to the minimum levels. In the year 2007, The APC program in FCCU was remodeled after the revamps in the process units.

The screenshot displays the 'GCU DMCplus Controller' interface. At the top, it shows 'FCS02021 Tag PI/O ER' and a timestamp of '08.01.24 11:14'. Below the title, there are fields for 'Controller: [redacted]', 'Clock: 32/60', and 'Initialise: [redacted]'. The main part of the screen is a table with the following columns: Type, Variable, Tag, Item, Current Value, Limits (Low, High), Target, Current Move, Maximum Move, and Service Switch. The table is divided into several sections: 'gas concentration', 'FF', 'CV', and 'LPG Residue Gasoline RVP'. Each row represents a different process variable with its corresponding tag and item name.

Type	Variable	Tag	Item	Current Value	Limits (Low, High)	Target	Current Move	Maximum Move	Service Switch
gas concentration	Recy Gaso GV1	GFC1701	SV	23.0	18.0, 23.0	23.0	0.00	1.00	ON
	GV2 System Pr	GPC062	SV	12.70	12.00, 12.70	12.70	0.00	0.10	ON
	GV3 Inlet tem	GT0088	SV	58.7	55.0, 61.0	59.0	0.02	1.00	ON
	L01 to GET	GFC087	SV	55.3	40.0, 72.0	55.7	-0.02	2.00	ON
	Tot. MTDGCU	GFS2101	SV	128.0	110.0, 165.0	129.3	0.09	1.00	ON
	GV104 Pr c/v	GPC1901	MV	2.5	2.0, 20.0	2.6	-0.01	2.00	ON
	GV104 Reflux	GFC2104	SV	56.2	45.0, 70.0	56.4	0.01	2.00	ON
FF	SV14 net O/H	FFC213	PV	79.3					ON
	Rx Temp	FT0064	PV	521.6					ON
	Amb. Temp	GT1120	PV	34.3					ON
CV	Fuel Gas Flow	GF1057	PV	6.3	4.0, 8.0	6.5			ON
	GV3 DP	GDP1760A	PV	0.330	0.100, 0.320	0.330			ON
	GV3 Top Temp	GT11711	PV	59.9	52.0, 63.0	59.8			ON
	GV3 Str Ratio	GV3VFR	CV	0.17	0.14, 0.18	0.16			ON
	GV3 Bta Temp	GT11712	PV	88.7	84.0, 89.0	89.0			ON
	GV104 Top Pr	GPC1901	PV	10.02	10.00, 10.50	10.00			ON
	GV104 T6 PCT	GCT098	CV	73.9	70.0, 78.0	73.8			ON
	GV104 B Ratio	GV4RFR	CV	0.41	0.35, 0.60	0.42			ON
LPG Residue Gasoline RVP	GV104 Bta Tem	GT12101	PV	165.2	162.0, 172.0	165.4			ON
	LPG Residue	GLPGRES	PV	5.88	5.00, 6.00	6.00	RQE: RUN	22/00	ON
Gasoline RVP	CCNRVP	PV	8.52	8.20, 8.50	8.50	RQE: RUN	18/00	ON	

DMC Plus APC controller running in our Gas Concentration Unit

A plant wide computer network connected to the DCSs of all the process units, utilities and tankfarm areas along with a real time database for storage and retrieval of process information, was commissioned in the year 2001.

A Light Ends Feed Preparation Unit (LEFPU) to supply Polybutenes feedstock to Cochin Refineries Balmer Lawrie Ltd. (CRBL), a joint venture company, was commissioned in March 1993. CRBL was later merged with KRL in April 2001. A Raffinate Purification Unit (RPU) for the manufacture of 10,000 TPA of Petroleum Hydrocarbon Solvent was commissioned in January 1994, with the technology developed by the in-house R&D Centre. Kochi Refinery started commercial production of Mineral Turpentine Oil (MTO) in March 1995, utilizing the existing facilities of the Refinery. Natural Rubber Modified Bitumen, another in house R&D product, started commercial production in September 1999.

A Diesel Hydro Desulphurisation (DHDS) plant with a capacity of 2.0 MMTPA was commissioned in March 2000, in order to reduce the sulfur content of diesel. In 2001 the entire tank farm operations were automated with the installation of Automatic Tank Gauging (ATG), DCS and online product blending systems.

All the major business management functions in Kochi Refinery are now driven by an integrated ERP system through the implementation of SAP R/3 Software.

An LPG bottling plant of nameplate capacity 44,000 TPA was commissioned in August 2003.

We started producing auto fuels MS and HSD conforming to Bharat Stage-II norms from January 2005, well ahead of the implementation of the new fuel quality norms in the region. This was achieved by revamping of the DHDS unit for capacity enhancement to 2.6 MMTPA and processing of the FCC unit feed (VGO) and Diesel in block out mode of operation in the DHDS unit. The FCC unit capacity also has been enhanced to 1.75 MMTPA by revamping in May 2005 along with installation of Oxygen enrichment facilities.

Projects – Recently completed

Single Point Mooring (SPM)

BPCL Kochi Refinery has set up an off shore crude oil receipt facility consisting of an offshore Single Point Mooring (SPM) system in Arabian Sea off Kochi, a storage terminal at Puthuvypeen near Kochi shore and off shore/on shore pipeline system connecting SPM to refinery through the shore tank farm. With the commissioning of SPM facilities BPCL can source the crude oil in large parcels in VLCC crude tankers and bring down the overall cost of transportation. The SPM project was commissioned by end November 2007 and the first ship was berthed at SPM on 3rd December 2007.



Ship berthed at SPM facility in Arabian Sea, off Kochi coast.

Projects – In Progress

CEMP – Phase II

In order to upgrade the refinery configuration to meet the Euro-II norms on auto fuel quality and enhance the capacity of the refinery to 9.5 MMTPA, Capacity Expansion cum Modernization Project (Phase – II) was planned. The project work is in progress and would be completed by December 2009. The process units coming up as part of the project are

- VGO HDS
- CCR reformer/Naphtha splitter/naphtha hydrotreater
- New sour water stripper unit, Amine regeneration unit and sulphur recovery units

Revamp of CDU-2, SWS in CDU-2 and LPG treatment facility in CDU-2 is also planned. To meet the additional power requirement one new Frame-6 GT with HRSG and a utility boiler(80 TPH) is also envisaged.

Performance High lights - 2007-2008

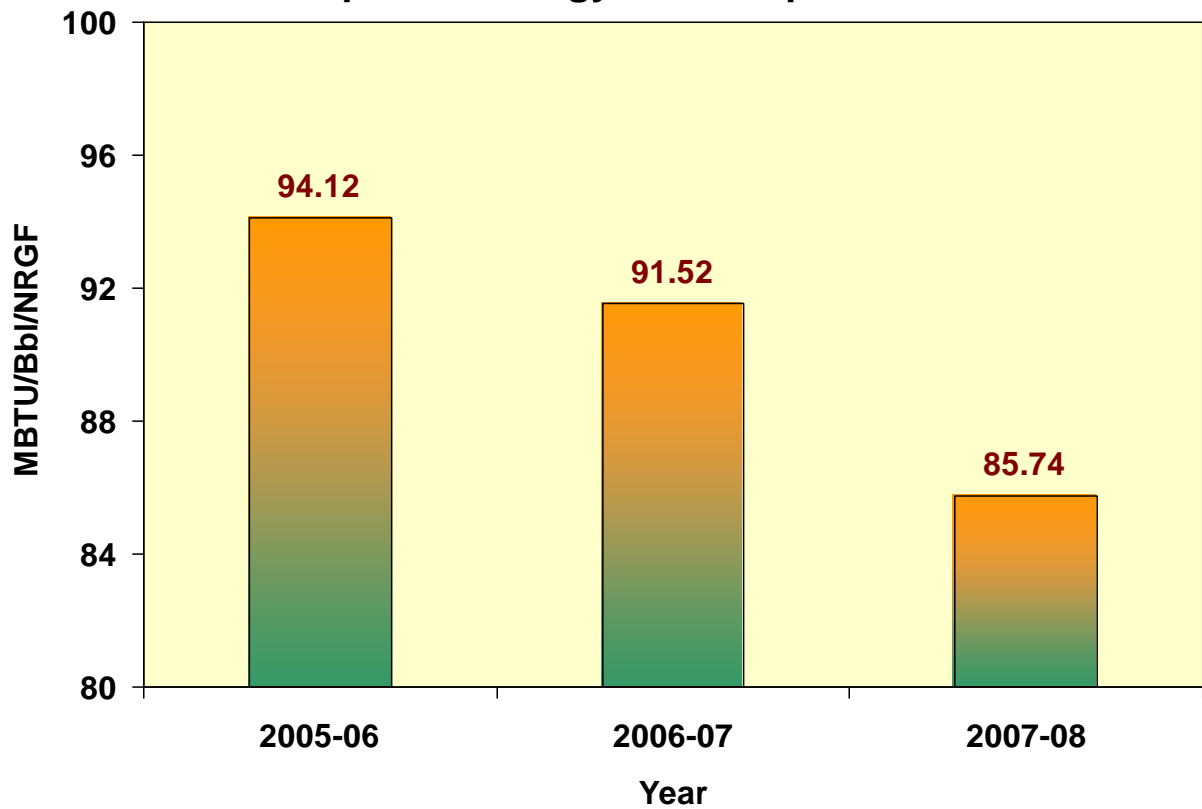
1. **Highest ever through put in the history of Kochi Refinery – 8.2 MMTPA.**
2. **All time production records for the following products**
 - **LPG**
 - **MS**
 - **HSD**
 - **ATF**
 - **Sulphur**
3. **The single point mooring facility (SPM) for receipt of large crude tankers commissioned in December 2007.**
4. **Energy Conservation Efforts resulted Fuel savings of more than 27,000 MT and green house gas emission reduction of around 1, 00, 000 MT.**
5. **In recognition of our efforts in green house gas emission reduction, we have been short listed for the 2008 Platts' Global Energy Awards under the category 'Sustainable Energy Initiative of the Year'.**
6. **Won the following coveted prizes**
 - **Gold Award in petroleum refinery sector for outstanding achievement in safety management from Green Tech Foundation for the year 2007.**
 - **Winner of Safety Innovation Award from 'The Institution of Engineers' for the year 2007.**
 - **Winner of Excellence award from Kerala State Pollution Control Board for the year 2007.**

(ii) Energy Consumption

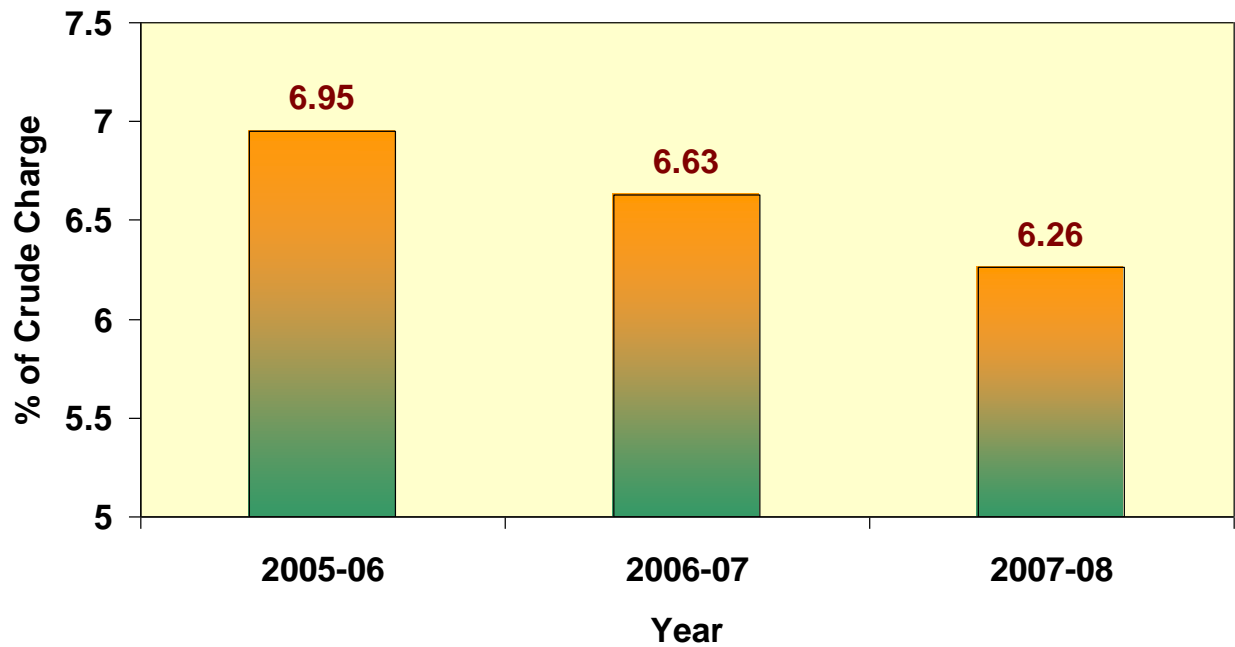
The two major indices of energy consumption for a petroleum refinery are Plant fuel and loss (% of crude oil processed) as well as specific energy consumption (MBTU/Bbl/NRGF). Despite the fact that, new units have been added in the refinery to improve product quality in compliance with increasingly stringent product quality norms we have been able to reduce our energy consumption by adopting energy efficient practices and implementing innovative process schemes for improving the energy efficiency of process units.

Below depicted are the trends on various energy performance parameters like specific energy consumption, energy cost and plant fuel & loss through the last three years.

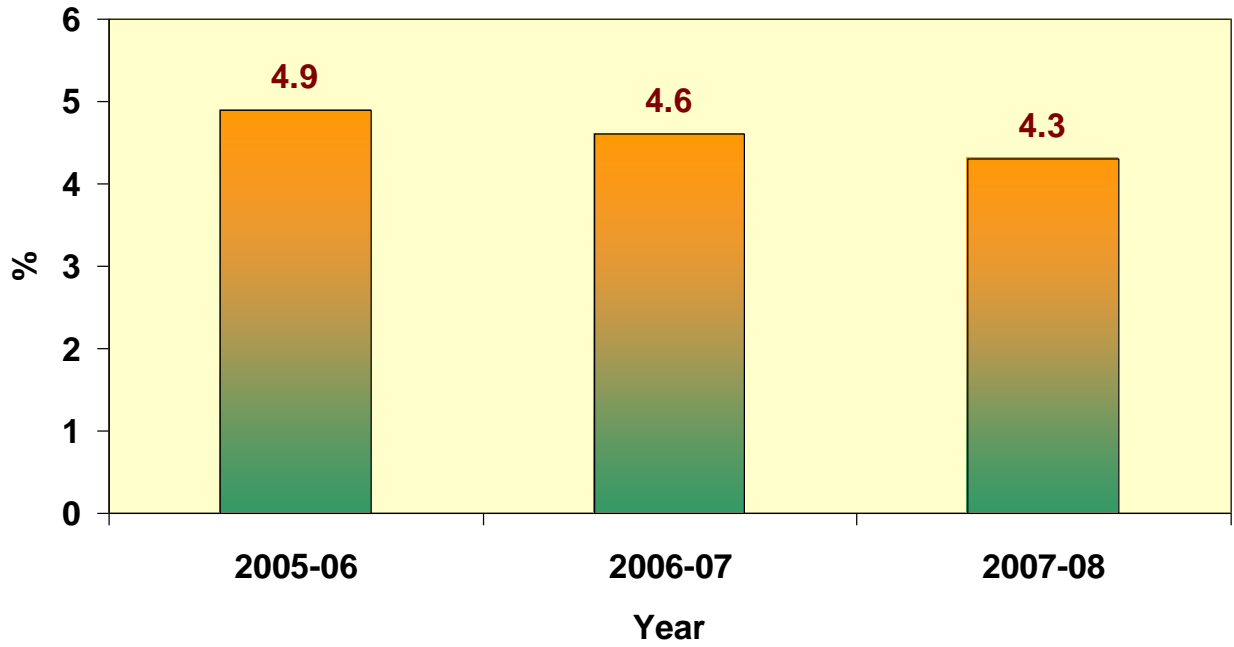
Specific Energy Consumption



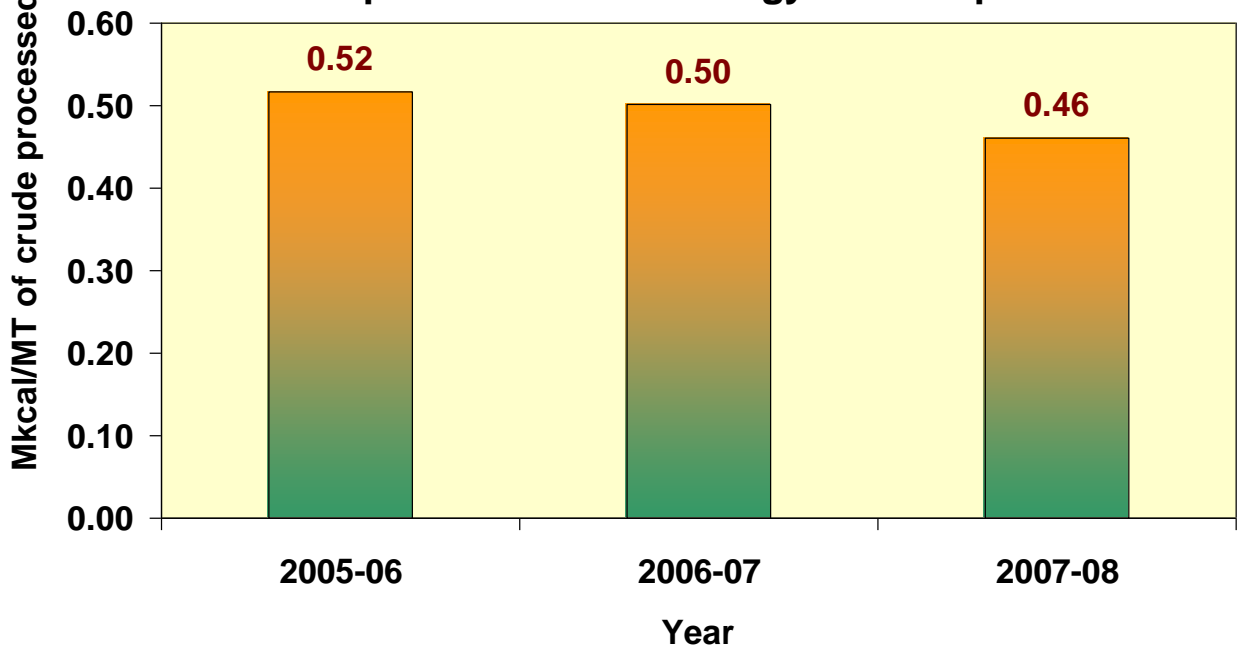
Plant Fuel & Loss



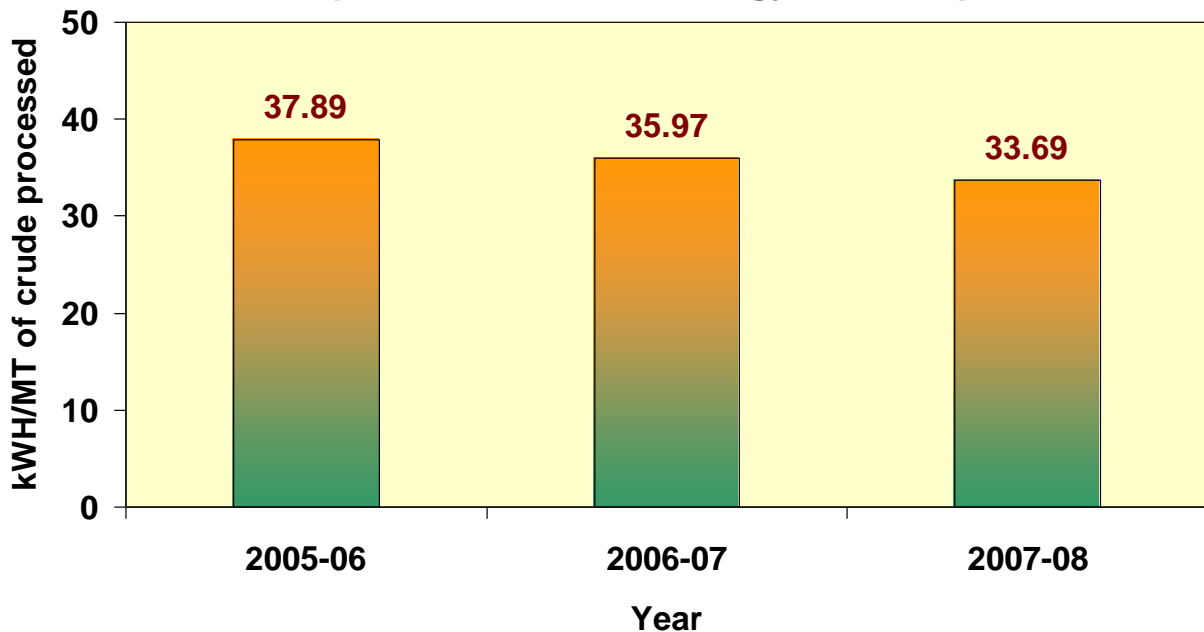
Energy Cost as % of Manufacturing Cost



Specific Thermal Energy Consumption



Specific Electrical Energy Consumption



As seen from the graphics above, last three years have witnessed tremendous improvement in our energy efficiency. Plant Fuel & Loss figure which was as high as 6.95% in 2005-2006, has been brought down to 6.26 % in 2007-2008. Similar trends were observed in specific energy consumption also.

Last year, in particular, has been a land mark year for BPCL Kochi Refinery. Apart from creating records in crude processing and production of various fuels, a number of energy conservation activities were taken up resulting in annual fuel savings of more than **27,000 Metric Tonnes**.

Reduction in green house gas emissions close to 1,00,000 tonnes were also achieved as a result of these efforts. Such impressive improvement in energy efficiency was made possible by the synergistic efforts of our Energy Group, Process Engineering, Other technical groups and operations group in implementing in-house innovations as well as the encon projects identified as part of our Brain storming sessions during the Shell Business Improvement Programme.

(iii) Energy Conservation Commitment, Policy and set up

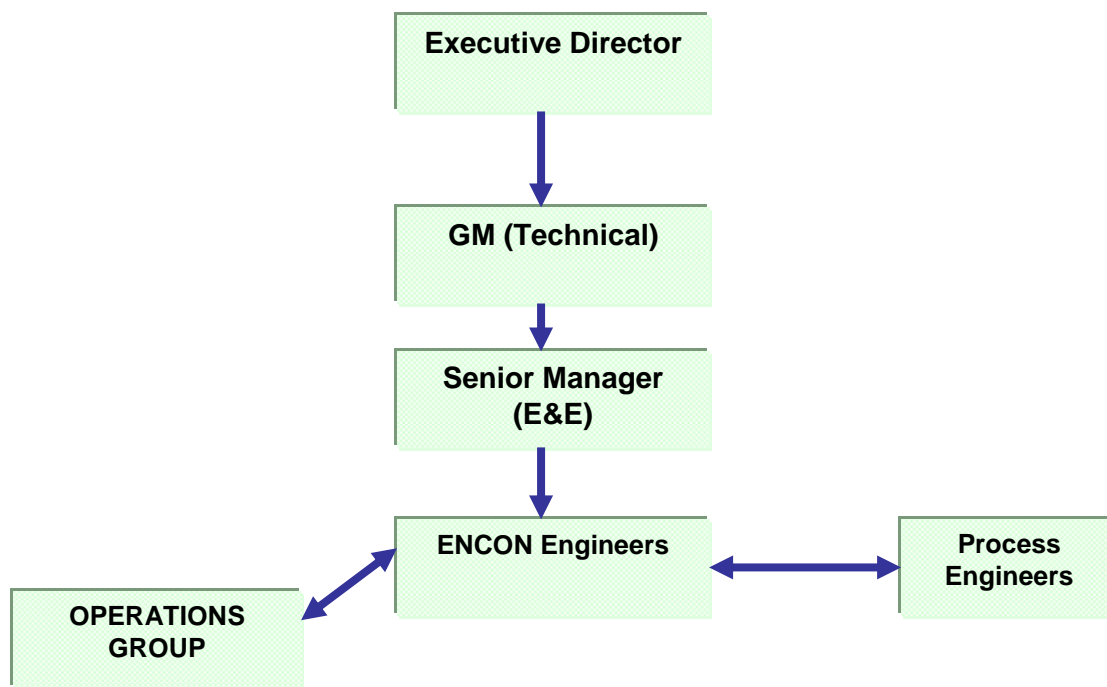
BPCL Kochi Refinery has a comprehensive Energy policy in sync with the corporate commitment towards sustainable development and judicious resource utilization. (Please See Annexure-1 for our energy policy)

Kochi Refinery's commitment to energy conservation begins at the design stage itself by incorporating energy efficient techniques to the new projects and revamps of existing facilities. The process schemes developed are also evaluated in the energy efficiency angle during the conception and HAZOP stages. Numerous process schemes are developed and executed, to improve the energy efficiency of our existing process units and storage/logistics facilities, based on our experience and ideas exchange with other refineries and organizations. We have fully optimized heat exchanger trains, air preheaters and steam generators in process heaters and a plant lay out fully utilizing the terrain of the area minimizing the pumping requirements.

We have a full-fledged Energy Conservation Cell under the direct guidance of General Manager (Technical). A Senior Manager heads this cell and he is supported by the Encon engineers for close monitoring of energy parameters, development of process schemes for improving energy efficiency of the refinery, adoption of new and innovative technology, regular energy audits etc. Under the guidance of our top management, the Energy Group continuously interacts with the operations group

and process engineers to identify new opportunities in energy conservation. We also have a platform called suggestion schemes, wherein any employee can suggest innovations and improvements in our operations, in order to improve the energy efficiency. Depending on the potential of the suggestion, the employee shall be suitably rewarded. Exchange of information, experience and information on energy conservation, with other refineries and knowledge organizations is also actively pursued.

Energy Conservation Organogram



(iv) Energy Conservation Achievements:

Details of major Encon projects implemented in the year 2007-2008 are given below.

1. Maximization of GT load based on Marginal cost advantage

In Kochi Refinery, there are three power generating machines available - the Gas Turbine (GT) of 21.98 MW, the Steam turbine (STG) of 17.8 MW, which is of double extraction and condensing type and the back pressure type steam turbine (TG) of 2.5 MW. About 3 MW power is imported from state grid to run non- critical plants. The available maximum load of TG is 1.5 MW. Rest of the load is shared between GT and STG.

STG has 3 stages, HP to MP, HP to LP and HP to condensing. As the latent heat of steam is lost to cooling water, HP to condensing is the costliest stage. Both the extractions (MP as well as LP steam) from STG are always maximized within the constraints of demand for steam in each pressure level and is more or less steady. So marginal cost of power (cost of additional MW generated) from STG is the cost of condensing power. The marginal cost of generating 1 MW additional power from GT is less than the marginal cost of power generation from STG through HP condensing route. Hence the proposal to maximize GT load by shifting 1.22 MW load from STG to GT.

Maximization of GT load based on marginal cost advantage		
Parameter	Value	Unit
Load shift from STG to GT	1.22	MW
Equivalent savings in condensed steam	6.89	TPH
Fuel equivalent of saved condensate	0.55	TPH
Incremental fuel(Kero-2) in GT	0.26	TPH
Incremental steam generation in HRSG	3.04	TPH
Equivalent fuel for incremental steam generation	0.24	TPH

Net fuel savings	0.53	TPH
Fuel savings MT/year	4414	tph
Net financial savings (Rs. In Lakhs)	553	lakhs

2. Optimization of deaerator systems for boilers

a)

In boilers UB7 and UB10, boiler feed water is heated initially to about 105 deg C for de aeration utilizing LP steam and is further heated to about 145 deg C (160 deg C in UB7) in boiler feed water heaters using MP steam, before admitted to the economizer section of the boilers. We have tried to shift the swap the heating pattern between the de aerator and boiler feed water heater to reduce the MP steam consumption.

Originally, de aerator pressure was kept around 0.3 kg/cm² in UB7 and 0.36 kg/cm² in UB10. The idea was to increase de aerator pressure and consequently the feed water temperature ex de aerator. At the same time, economizer inlet temperature was kept unchanged. This measure has increased LP steam consumption in de aerator and reduced MP steam consumption in feed water heater. UB7 de aerator pressure was increased to 1.9 kg/cm² and UB10 de aerator pressure was increased to 1.6 kg/cm². Total increase in LP steam consumption was approximately 7.08 T/ Hr, where as reduction in MP steam was 7.23 T/ Hr.

Increased consumption of LP steam is routed through the LP extraction from STG, there by reducing approximately 2.76 MT of condensing load per hour.

b)

In UB3 boiler, feed water pump turbine was in operation continuously. Being an old design, exhaust of this turbine was let to atmosphere. Even when this boiler was stand by, the pump was operated continuously, supplying feed water to nearby boilers UB4 and UB5. Reason behind this was for utilizing return condensate connected to UB3 de aerator. The condensate connected to UB3 de aerator was re routed to ARU condensate line, which is going to CPP and the UB3 de aerator was isolated. Feed water to UB3, 4 and 5 now is being supplied centrally from CO boiler de aerator, where spare capacity is available. This measure has enabled us to save approximately 2 T/ Hr of MP steam.

Optimization of deaerator systems		
Parameter	Value	Unit
Total increase in LP steam consumption	7.08	TPH
Increase in LP steam Extraction	7.08	TPH
Reduction in STG condensation corresponding to increased LP extraction	2.76	TPH
Fuel savings corresponding to saved condensate	0.22	TPH
Fuel savings MT/year	1831	
Steam savings due to shutdown of UB-3 feed water pump	2	TPH
Fuel savings on account of saved steam	0.16	TPH
Fuel savings MT/year	1318	
Total Fuel savings MT/year	3150	
Total financial savings (Rs. In Lakhs)	592	

3. Reduction of steam to amine regenerator reboiler in DHDS ARU.

The centralized amine regeneration unit in BPCL-Kochi Refinery, having a capacity of 250 m³/h was commissioned along with the DHDS facilities in the year 2000. Originally, the DEA concentration was kept at around 22.5 %wt. The total solvent circulation rate was maintained at 150 m³/h in Diesel case and 175 m³/h in VGO case. The stripping steam used was in the range of 65 kg/m³ of DEA. By increasing the DEA concentration to approximately around 29 %wt, the amine circulation rate could be reduced to 115m³/h in diesel and 125 m³/h in VGO with the same stripping steam ratio. This caused a net savings of approximately 2-3 tph of LP steam.

Steam Optimization in Amine Regenerator		
Parameters	Before Implementation	After implementation
DEA circulation rate, M ³ /hr	150	115
Stripping steam ratio, Kg/m ³	65	65
Steam Flow(MT/hr)	9.75	7.48
Net steam savings , MT/hr	2.28	
Net Fuel oil savings , MT/hr	0.169	
Fuel oil savings MT/year	1395	
Financial savings, lakhs/year	262	



Amine Regeneration Unit - DHDS

4. Maximization of crude circulating refluxes for increasing crude preheat & Crude column pressure optimization in CDU-2.

The objective of the scheme was to optimize the crude column circulating refluxes with the objective of maximizing the crude preheat temperature with out affecting product quality and minimize crude column operating pressure to reduce crude furnace duty.

Earlier the Advanced Control program in CDU-2 was not set to maximize the bottom circulating reflux but to improve separation between various fractions. It was observed that, while there is a benefit in improving separation between naphtha and Heavy Naphtha there was no real margin in improving separation between other products as Kerosene stream is not limited by flash specification and heavy naphtha stream is blended into diesel. This was translated in to an opportunity, where in we could maximize the bottom circulating refluxes by reducing other upper circulating refluxes, with out compromising on requisite product quality by ensuring sufficient internal reflux from the top tray for naphtha / heavy naphtha separation. The results were improved crude preheat temperature and a reduced crude furnace duty. In CDU-2 we have maximized HGO and LGO circulating refluxes by reducing upper kerosene reflux to maximize preheat. This has enabled a reduction of 0.89 T/ Hr of fuel in the crude charge heater.

Minimizing crude column operating pressure would result in a net reduction in Crude furnace duty. Earlier, the crude column in CDU-2 was operated at a fixed pressure. This was resulting in sending out valuable products from crude column overhead to fuel gas during the day-time when the ambient temperature is higher. During the night time, when the ambient temperatures are lower, we could reduce the operating pressure. A new philosophy was adopted to operate crude column at lowest pressure just sufficient to suppress any flaring and use advanced control to adjust the operation so that the operating pressure is minimized during night time and increased during day time so that flaring is minimized and crude furnace duty is also reduced.

CDU-2 Column Optimization		
Parameters	Value	
Average gas flaring from column before control, Kg/hr	224.7	
Average gas flaring from column after control, Kg/hr	109	
Total gas savings, Kg/hr	116	
LPG savings, Kg/hr	90	
Plant fuel price, Rs/MT	18785	
LPG price, Rs/MT	30484	
LPG saving, MT/year	745	
Financial savings, lakhs/year	58	
Preheat Optimization	Before Implementation	After Implementation
Average crude charge, MT/hour	400	400
Average Preheat Temperature, deg C	278.6	280.5
Increase in preheat temperature , deg C	1.9	

Increase in heat gain in preheat network, Kcal/hr	554800
Calorific Value of plant fuel, Kcal/Kg	9550
Fuel savings, Kg/hr	64.5
Financial savings(Rs. In lakhs)	100.4
Total Financial savings due to CDU-2 optimization	158
Total Fuel savings, MT/year	1279

5. Operation of the recycle gas compressor in DHDS on LP extraction mode

The DHDS unit of BPCL- Kochi Refinery operates a 4 MW turbine driven centrifugal compressor for circulating the recycle gas. HP steam drive is used for the turbine. The machine is normally operated at a speed range of 7800-9000 rpm, depending upon process requirements. When the compressor is operated ≥ 9000 rpm LP steam is extracted to improve the efficiency of the system. This caused a net savings of approximately 3 tph of HP steam.

LP steam extraction in Recycle gas compressor	
Parameters	Value
Net steam savings , MT/hr	3.00
Net Fuel oil savings , MT/hr	0.222
Fuel oil savings MT/year	1840
Financial savings, lakhs/year	346

6. Preheat improvement due to LCO processing in DHDS

After the catalyst change over in the DHDS unit, the LCO processing has been increased to 15% of the total DHDS charge. Since the olefin saturation reactions are exothermic, an increase in the pre heat of 8 deg C could be achieved at the heater inlet. This has saved about 1440 Tons fuel per annum.

Preheat improvement due to LCO processing in DHDS	
Parameters	Value
Preheat increase in DHDS , deg C	8
Net Fuel oil savings , MT/hr	0.174
Fuel oil savings MT/year	1440
Financial savings, lakhs/year	270

7. Steam optimization in MAB compressor using advanced control

In Fluidized Catalytic Cracking Unit (FCCU), Steam driven Main Air Blower (MAB) supplies air to regenerator for regenerating catalyst by burning of the coke deposited over the catalyst. MAB is provided with anti surge controller to protect the blower from surge by venting the air. The objective of FCCU APC is to maximize catalyst circulation rate for the available feed rate and minimize the MAB airflow rate. The minimum required MAB airflow rate corresponding to coke produced is controlled based on the regenerator model developed in the APC program.

The MAB trip set value for the surge ratio is 40% and normal operating value was maintained at 60% with the margin of safety 20 %. Subsequent to the introduction of PDMR (Proportional Derivative Manual Reset) controller for anti surge ratio control in April 2007, we were able to reduce the normal operating value of surge ratio to 52% by reducing the margin of safety. This has resulted in lower air vent requirement and subsequently lower steam consumption in the MAB turbine.

MAB surge ratio PDMR control - Steam Savings		
Parameters	Before Implementation	After implementation
FCCU charge, MT/hr	200	201
MAB surge ratio	62.2	51.11
Air Flow(MT/hr)	116.89	106.48
Steam Flow(MT/hr)	37.05	34
Net steam savings , MT/hr	3.05	
Net Fuel oil savings , MT/hr	0.226	
Fuel oil savings MT/year	1871	
Financial savings, lakhs/year	351	

8. Running extraction turbine in place of motor in UB10

In UB10 boiler, there are two auxiliary drive turbines for boiler feed water pump and FD fan. For the same service, two motor drives also are available. The operation practice previously was to operate FD fan on turbo drive and feed pump on motor drive. There was a constraint for evacuating the MP steam, if both equipments were on turbo drive. It was observed that HP steam needed to be let down through PRDS elsewhere, as MP steam demand was more.

As a trial, the hand valve for FD fan turbine was closed for reducing steam consumption and the available power output of the turbine was found adequate to supply air for the normal operating range of the boiler (about 80% of MCR). This has enabled us to keep feed water pump turbine also in line along with FD fan turbine and reduce PRDS opening. As a result, the power consumption of feed water pump motor (about 190 kW) is saved.

Extraction turbine in place of motor in UB10		
Parameters	Value	
Power savings due to shutdown of feed pump motor	190	KW
Equivalent fuel savings	0.10	TPH
Net fuel savings, MT/year	791	MT
Financial savings, Rs. In lakhs/year	149	Lakhs

9. Preheat temperature optimization in FCCU.

As part of the FCCU revamps, the pre heat exchanger network was reconfigured using pinch technology and an additional exchanger FE-103 added to the network. This resulted in an improvement of preheat from around 290 deg C to 310 deg C (i.e. an increase of 20 deg C).

Preheat Optimization in FCCU - Energy Savings	
Parameters	Value
FCCU charge rate, MT/hr	200.0
Specific Heat of FCCU feed , Kcal/Kg deg C	0.6
Feed preheat temperature, before optimization (deg C)	290
Feed preheat temperature, after optimization (deg C)	310
Reduction in charge heater heat duty, MMKcal/hr	2.4
Fuel oil savings MT/year	2081
Financial savings, Lakhs/year	391

10. Heater efficiency improvement using stack draught adjustment.

In our process heater, stack draughts were optimized by the operation of stack dampers and air louvers in individual burners, to minimize the excess air to the practically possible levels. This exercise was done in April 2008 and the net fuel savings achieved from this exercise was 1242 tonnes for the year of fuel oil, which is equivalent to 233 lakhs of financial savings per year.

11. New condensate recovery system in VR/Plant fuel tank farm and improvement of existing condensate recovery scheme at VGO tank farm.

A condensate recovery system was commissioned in VR/Plant fuel tank farm to recover 1.4 t/hr of condensate and route it to the UB6/CO boiler deaerator. The condensate recovery system is a package system consisting of a flash vessel, accumulator and a MP steam powered condensate pump. Similarly the existing condensate recovery system at VGO tank farm was put back online after trouble shooting of it's pressure reducing valve technical issues.

Condensate recovery Systems - Energy Savings	
Parameters	Value
Condensate recovered from Plant Fuel Tank farm, T/hr	1.4
Heat Recovered, Kcal/hr	84000
Fuel oil savings MT/year	81
Financial savings, lakhs/year	15
Condensate recovered from VGO Tank farm, T/hr	1.0
Heat Recovered, Kcal/hr	60000
Fuel oil savings MT/year	58
Financial savings, lakhs/year	11
Total Fuel oil savings, MT/year	139
Total Financial savings, lakhs/year	26



Condensate Recovery System at Plant Fuel tank farm

12. Optimization of power consumption in utility boiler drives and auxiliaries.

After conducting a study on utilizing the spare capacities of the drives in utility systems, we could switch off a few drives from service, by combining the flow requirements for a few boilers. Through this measure, we could save 1443 tonnes of fuel oil per year and in financial terms Rs. 271 lakhs per year.

Optimization of power consumption in utility boiler drives and auxiliaries		
Parameter	Value	Unit

Power savings by shut down of COB feed water pump	148	kW
Power savings by shutdown of HRSG feed water pump	82.5	kW
Power savings by shutdown of GT cooling water water pump	80	kW
Power savings by running of lower capacity DMW pump	30	kW
Power savings by stoppage of UB8/9 scanner air fans	6	kW
Total power saved	346.5	kW
Equivalent fuel savings	0.17	TPH
Total fuel savings , MT/year	1443	Tonnes
Total Financial savings, Rs. In Lakhs	271	Lakhs

13. Reduction in STG condensation due to increase in LP extraction.

After the stoppage of UB5 feed water turbine, additional LP extraction from STG was resorted due to the available cushion in LP steam balance. Through this measure, we could save 965 tonnes of fuel oil per year and in financial terms Rs. 181 lakhs per year.

Increase in LP extraction of STG due to stoppage of UB 5 turbine		
Parameter	Value	Unit
Additional LP extraction from STG due to stoppage of UB5 FD fan turbine	4.5	tph
Equivalent savings in condensation in STG	1.754237	tph
additional steam consumption for keeping boiler pressurized	0.3	tph
Net steam saved	1.454237	tph
Equivalent fuel saved	0.117	tph
Total fuel savings , MT/year	965	Tonnes
Total Financial savings, Rs. In Lakhs	181	Lakhs

14. Fuel savings due to improved heat recovery in EE11 heat exchanger.

EE11 heat exchanger is used for pre heat of boiler feed water to UB-6 in exchange with hot HVGO stream from FPU unit. The UB-6 boiler water stream alone was unable to absorb all the heat available in the hot HVGO stream. Hence, the boiler feed water to UB-4/5 boiler were also combined with the UB-6 boiler feed water and sent to EE-11. Hence all the heat available at EE-11 could be absorbed. The scheme could save 983 tonnes of fuel oil, which is 185 lakhs per year, in financial terms.

Improved heat recovery in EE11 heat exchanger		
Parameter	Value	Unit
Additional feed water thru EE11	30	TPH
Inlet Temperature of BFW at EE11	111	deg C
Outlet Temperature of BFW at EE12	145	deg C
Additional heat pick up	1020000	kcal/hr
LCV of fuel	9550	kcal/kg
Reduction of heat load in boilers	1020000	Kcal/hr
equivalent fuel savings	0.12	TPH
Total fuel savings , MT/year	983	Tonnes
Total Financial savings, Rs. In Lakhs	185	Lakhs

15. Optimization of Boiler blow down in Utility boilers

The blow down from the HP boilers was reduced from 6.9% to 4.4% by closer monitoring of drum silica. The measure has resulted in around 1760 tonnes of fuel oil savings per year and correspondingly 331 lakhs per year.

Optimization of boiler blow down		
Parameter	Value	Unit
Average load of HP boilers	315	TPH

Blow down reduction	2.5	%
Qty of blow down water saved	7.88	TPH
sensible heat of blow down water	262	kcal/kg
LCV of fuel	9550	kcal/kg
Equivalent fuel savings	0.21	tph
Total fuel savings , MT/year	1760	Tonnes
Total Financial savings, Rs. In Lakhs	331	Lakhs

16. Desulphurization of vacuum column off gases and the associated enhanced heat recovery in EH1 APH.

In November 2007, we installed an amine absorption system for desulphurisation of low pressure vacuum column off gases, based on in house technology, at a cost of approximately 1.75 crores. The desulphurised offgas is then burnt in the vacuum heater furnace. Apart from the very significant reduction of 765 tonnes of sulphur dioxide emissions per year, the energy conservation angle of this project is the enhanced heat recovery from the EH1 air pre heater due to the elevation of dew point.

The process involves scrubbing the H₂S rich offgases with diethanol amine in an absorber and the absorption of H₂S gas in amine. The H₂S rich amine is then regenerated in the centralised amine regeneration unit in the refinery and H₂S is converted to elemental sulphur in sulphur recovery unit. The real challenge to the success of the process is the low pressure (about 100 mmwc) available for amine scrubbing and design of system for such a lower pressure drop. Such low pressure amine absorption systems are not known to be offered or commercialised by consultants.

The additional advantages are increase in heat recovery in process heater due to enhancement of flue gas dew point, improved reliability of heater system due to less cold end corrosion in heater and air preheater system.

Desulphurization of vacuum column off gases & Enhanced heat recovery in EH1 APH	
Parameters	Value
Fuel gas savings due to reduction of flue gas exit temperature(Kg/hr)	25
Hours of operation considered	8280
Fuel gas savings in Metric Tonnes per year	207
Equivalent fuel oil price(Rs./MT)	18785
Total Financial Benefits due to fuel gas savings (Rs. In Lakhs) per year	38.9
Total investment incurred (Rs. In Lakhs)	175



EV-6 amine absorber for vacuum column off gases

17. Reduction in purge gas flaring in Hydrogen unit.

The purge gas formed during the hydrogen production contains CO, CO₂, CH₄ and Hydrogen. Since, it contains significant calorific value (approximately 1200 Kcal/Kg), it is utilized in the reformer heater as fuel. Due to the loss in activity of catalyst in Pressure Swing Adsorption Unit (PSA) in Hydrogen unit, the hydrogen content in the purge gas was found to be higher than the normal content. Hence, to avoid reformer heater skin temperatures going beyond the safe limits, we had to limit the purge gas utilization in reformer heater and flare some quantity of purge gas. We replaced the entire batch of PSA catalyst with a new batch at a total investment of approximately Rs. 420 lakhs. This led to the complete utilization of purge gas in reformer heater and elimination of purge gas flaring.

Reduction in purge gas flaring in Hydrogen unit		
Parameter	Value	Unit
Average purge gas flaring rate prior to catalyst change	1000	Kg/hr
Purge gas calorific value	1640	Kcal/Kg
Total heat duty in Flaring	1640000	Kcal/hr

Equivalent naphtha saved after catalyst change	156	Kg/hr
Total naphtha savings per year	1288	Tonnes
Total Financial savings on account of heat duty saving, Rs. in lakhs	425.1	Lakhs

18. Reduction in steam requirement by raising 5 deg C of inlet steam temp in STG

By increasing the inlet temperature of STG by 5 deg C, it was found that we could increase the power generation by around 0.174 MW. This is equivalent to fuel savings of 652 tonnes per year (Rs. 123 lakhs per year).

Reduction in steam requirement by raising inlet steam temp in STG		
Parameter	Value	Unit
Additional generation of power due to 5 deg C rise in inlet temp	0.174	mw
Steam equivalent	0.983051	tph
Fuel equivalent	0.08	tph
Total fuel savings , MT/year	652	Tonnes
Total Financial savings, Rs. In Lakhs	123	Lakhs

(v) Energy conservation plans and targets.

Continuing our good work in recent years, we have a number of energy conservation projects in progress and being completed.

Sl.No	Energy Conservation Scheme / Programme	Fuel savings (MT per year)	Financial Benefits (Rs. Lakhs/ year)	Investment (Rs. In lakhs)	Expected Completion
1	Replacement of metallic blades of 57 air fin fans with FRP blades in process units.	1994	375	50	2009 March
2	Application of friction reduction coating on 29 numbers of cooling water pumps.	690	130	87	2010 March
3	Replacement of Naphtha stabilizer reboiler (LH1) with a steam reboiler.	1343	252	150	2009 Jan.

4	Removal of overhead column compressor in Crude distillation unit-1 by routing overhead gas directly to heaters after amine wash.	255	48	30	2009
5	Installation of VFD drives in 23 LT motors at various locations inside the refinery.	198	41	82	2010 Sept.
6	Optimization of auxiliary firing potential in FCCU waste heat boiler and increase of TG load by 0.5 MW.	1656	311	258	2009
7	Provision of LP steam air heater ahead of cast APH to mitigate cold end corrosion and reduce the down time of air pre heaters	3104	583	50	2009 Dec.
8	Optimization of excess air in process heaters and boilers through automatic air fuel ratio based combustion control scheme.	1656	311	25	2009 Sept.
9	Installation of step less control in DHDS make up gas compressor.	409	77	183	2010 March
10	Swapping of MP steam with LP steam for product strippers in FCCU & CDU1.	3411	641	92	2009 Jan.
11	Efficiency improvement of UB 5 boiler.	1689	317	146	2009
12	Purge gas optimization in FCCU, CDU-2 and DHDS flares.	602	113	Nil	2009 Dec.
13	Replacement of mineral wool insulation by perlite	122	23	45	2008 April
14	Installation of CP-102 pump in parallel with SWP-5 for Stripped water pumping.	84	16	2	2009 Sept.
	Grand Total	17214 T	3238 Lakhs	1200Lakhs	

(vi) Environment and safety

Environment

Kochi Refinery continues to strive hard for the improvement of environment performance and prevention of pollution. Commitment for environmental protection starts at the design stage itself by selecting environmental friendly technology. Regular audits are carried out by various internal and external agencies and the recommendations are promptly implemented.

We are the first industry in the state of Kerala to get consent from the Pollution control board for discharge of treated effluents into the inland waters. We are also the first industry in Kerala to get the ISO 14001 certification.

Kochi Refinery joined hands with Cochin port trust for the set up of Tier-1 facilities for combating oil spill. Additional facilities have been installed for oil spill combat, at our SPM (Single point mooring) location also.

Kochi Refinery has always been in the fore front of product innovation also. Our product Natural rubber modified bitumen (NRMB) leads to longer service life of roads and better fuel efficiency of vehicles plying on it. Similarly, Bitumen emulsion eliminates the need for heating the bitumen before application, doing away with the pollution associated with it and the discomfort of workmen working in road construction.

Highlights of our Environment protection activities in the year 2007-2008

Amine Treatment of H₂S bearing vacuum column offgases

In November 2007, we installed an amine absorption system for desulphurisation of low pressure vacuum column off gases, based on in house technology, at a cost of approximately 1.75 crores. The desulphurised offgas is then burnt in the vacuum heater furnace. The process involves scrubbing the H₂S rich offgases with diethanol amine in an absorber and the absorption of H₂S gas in amine. The H₂S rich amine is then regenerated in the centralised amine regeneration unit in the refinery and H₂S is converted to elemental sulphur in sulphur recovery unit. This project was extremely challenging due

to the very low pressure of vacuum column off gases (around 100 mmwc). Such low pressure amine absorption systems are not known to be offered or commercialised by consultants.

The project has resulted in approximately 765 tonnes of SO₂ emission reduction per year. The additional advantages are increase in heat recovery in process heater due to enhancement of flue gas dew point, improved reliability of heater system due to less cold end corrosion in heater and air preheater system. The increase in heat recovery in air preheater is equivalent to reduction in carbon dioxide emissions of 567 tonnes per year.

✚ Green House Gas Emission reduction

Through the implementation of eighteen energy conservation projects and ideas, we were able to reduce the green house gas emissions from our refinery by nearly 1 lakh tonnes during last year. Details are available in the section on energy conservation projects in 2007-2008.

✚ Reduction Furnace for NH₃ stream in DHDS-SRU

A reduction furnace has been installed in our sulphur recovery unit, to convert the NH₃ generated in sour water stripper unit to nitrogen by controlled oxidation in the furnace atmosphere. The project, completed at a cost of approximately twenty million INR, was commissioned in December 2007. The reduction furnace is designed to handle around 500 Kg/hr of ammonia rich gas from sour water strippers. The NO_x content in the outlet flue gas will be a maximum of 250 ppmwt. Reduction furnace prevents around 850 Kg/hr NO_x emission, which would have occurred in the absence of reduction furnace.



Reduction Furnace in DHDS SRU unit.

✚ New Effluent Treatment Plant at Shore Tank Farm

A new effluent treatment plant has been set up in the Shore Tank Farm at Puthuvypeen as part of SBM (Single Buoy Mooring) facilities at an estimated project cost of Rs 5.05 crores.



ETP in Shore tank farm

✚ Rain water harvesting scheme & Green belt at Shore Tank Farm

We have constructed a rainwater harvesting pond at Shore tank farm (Puthuvypeen) in an area of 5 acres, with a capacity to collect 25000 m³ of rainwater. The scope of rainwater harvesting scheme implemented in STF area is to collect and store rain water falling in the entire STF area of 170 acres. The collected rain water is used for replenishing the water supply for fire fighting and watering the green belt area where around 6000 numbers of various types of trees are planted. The total expenditure for the project was around Rs. 20 lakhs.

✚ Environment Friendly Oil recovery and disposal of Oily sludge

We had commissioned a process to recover oil from the oily sludge, an identified hazardous waste. The project was kick started in the year 2003 and till March 2008, we have processed over 35000 MT of accumulated oily sludge and recovered nearly 10000 MT of precious oil. The recovered oil is

reprocessed in the crude units. The sludge after treatment is bioremediated and the non-hazardous residue is disposed off in secured landfill. In the year 2007-2008 alone, 3934 tonnes of oily sludge was treated and 1157 tonnes of oil was recovered.



Bio remediation in progress at the sludge recovery site

We have adopted in-situ cleaning and oil recovery for the tank bottom sludge in crude oil tanks, which are decommissioned for maintenance and periodic inspection. Recently, we had carried out in-situ cleaning of two crude oil storage tanks through chemical cleaning and 'BLABO' process (patented by M/s Balmer & Lawrie).

Clean Development Mechanism

The following Clean Development Mechanism Projects (CDM) under the UN Framework Convention on Climate Change (UNFCCC) are under consideration.

- 1) Installation of step less control in DHDS make up gas compressor
- 2) Efficiency and reliability improvement of UB5.

We have also received several awards in recognition of our efforts on the environmental front.

Recent recognitions

- ✚ 7th Annual Greentech Excellence Award (Gold Award) in Petroleum Refinery sector for outstanding achievement in Environment Management for the year 2006.
- ✚ Excellence Award from Kerala State Pollution Control Board for the years 2006 & 2007, for making substantial efforts to improve the environmental performance.

Safety

Our company is always vigilant in making the refinery a safe place for its employees and has invested substantially in automated safety and process control systems to ensure safe working conditions. We have recently completed 11 million man hours and 1000 man days with out accident.

Major initiatives undertaken in 2007-2008

- Dead man valves provided for water draining lines of all LPG spheres to prevent accidental draining of LPG along with water.
- Guidelines for erection & usage of scaffolding have been established and improved scaffolding materials have been purchased.
- Established financial deterrent scheme for violation of HSE norms by contractors.
- Formulate various guidelines and programmes /systems /procedures so as to prevent accident/loss and create safety awareness amongst employees.
- Work permit system was revised in line with the revised OISD standard –105, which have more stringent safety checks.
- Initiated hands on training on the usage of respiratory PPE while handling toxic gases for employees in the operating areas.
- Provided PPE's for truck drivers and Khalasis during filling of trucks.
- Hydraulic analysis / firewater net wok has been done for optimizing pipeline sizing and pump requirements.
- Up graded the PPE standards.
- Quick closing coupling valve provided for LPG truck loading bays for immediate removal of LPG truck, in case of emergency.
- Upgraded the safety interlock system in mobile cranes.
- First aid training has been included in the training programme for employees.
- Introduction of safety driving tests for contract drivers engaged inside the Refinery.

Recent Recognitions

- ✚ Safety innovation award by Institution of Engineers (India) - **2008**.
- ✚ Gold award in Petroleum Refinery sector for Safety management by Greentech Foundation - **2008**
- ✚ Award for outstanding safety performance by National Safety Council, Kerala Chapter - **2007**.

21. Whether any dispute pertaining to statutory requirements of safety and pollution control is pending with any Government Agency. If yes, give details:

There are no disputes pending with any government agency pertaining to statutory requirements of safety and pollution control.