



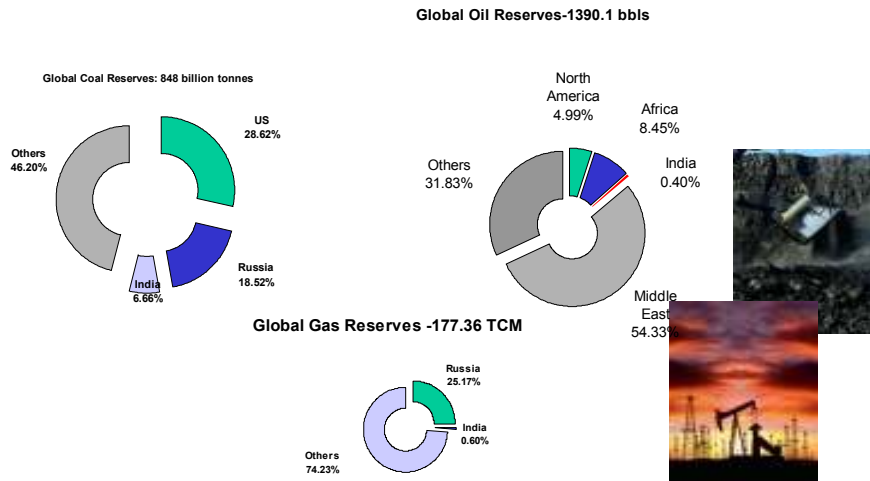
WELCOME



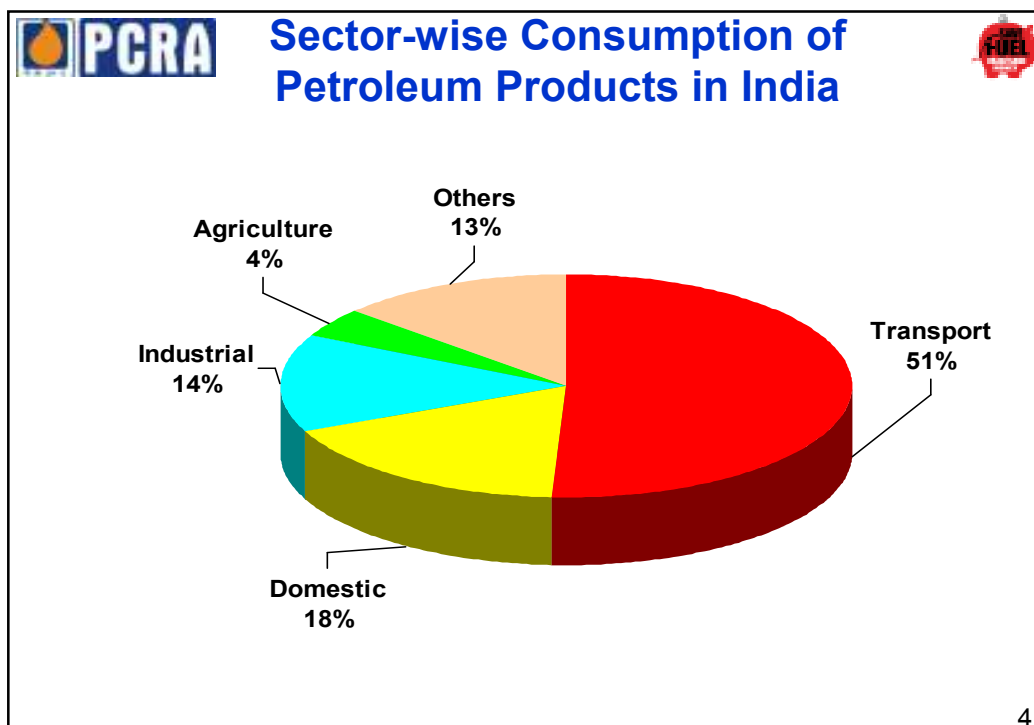
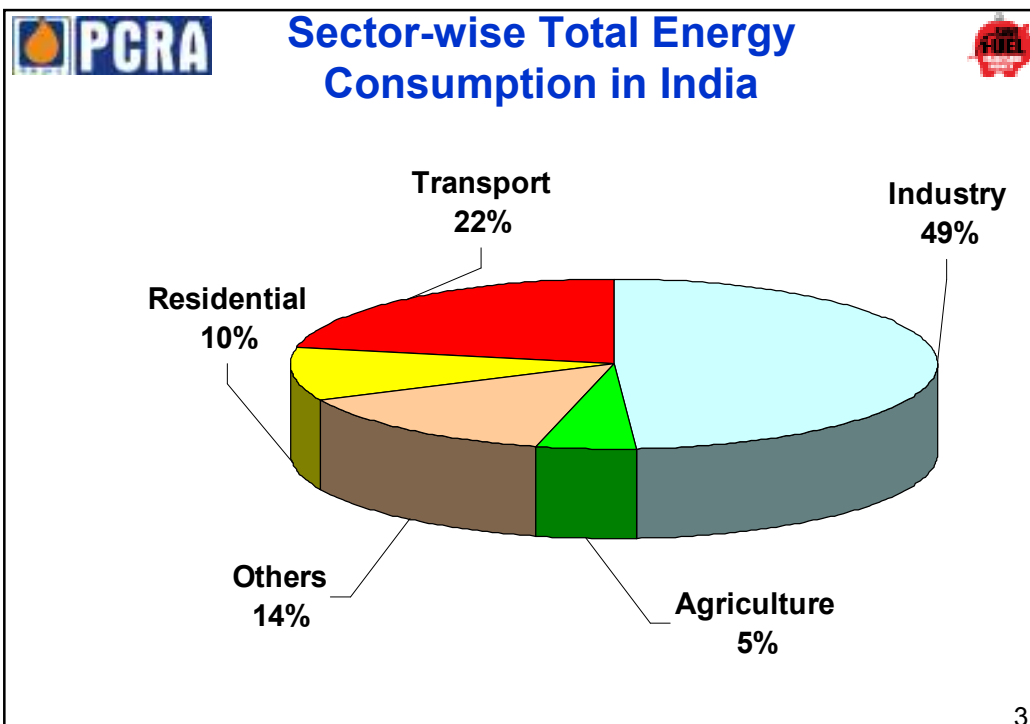
Energy Conservation Initiative & Drive in Hydrocarbon Sector



Global Primary Energy Reserves



Source : *BP statistical Review, June 2008



Energy Intensity in India:

- 3.7 times of Japan
- 1.55 times of US
- 1.47 times of Asian average
- 1.5 times of World average



There exists a huge scope for improvement

Sl. No.	Sub Sector	%age of Energy in Total Production Cost	Energy Conservation Potential %
1.	Iron & Steel	15.8	8-10
2.	Refineries	6.0	8-10
3.	Textiles	10.9	20-25
4.	Cement	34.9	10-15
5.	Chlor – Alkali	15.0	10-15
6.	Pulp & Paper	22.8	20-25
7.	Aluminum	34.2	8-10
8.	Ferrous & Foundry	10.5	15-20
9.	Petrochemical	12.7	10-15
10.	Ceramics	33.7	15-20
11.	Glass	32.5	15-20
12.	Fertilisers & Pesticides	18.3	10-15
13.	Sugar	3.4	20-25
14.	Ferro - Alloys	36.5	8-10

Specific Energy / Fuel Consumption

Sl. No.	Type of Industry	SFC/SEC
1.	Petroleum Refinery	68 Mbtu / Bbl / NRGF
2.	Aluminium	658 KWh per ton
3.	Fertilizers	11.25 Mkal per ton
4.	Iron and Steel	6.27 GJ per ton
5.	Cement	689 Kcal per kg clinker 21.43 KWH per ton of clinker
6.	Textile	67 KWH per Kg

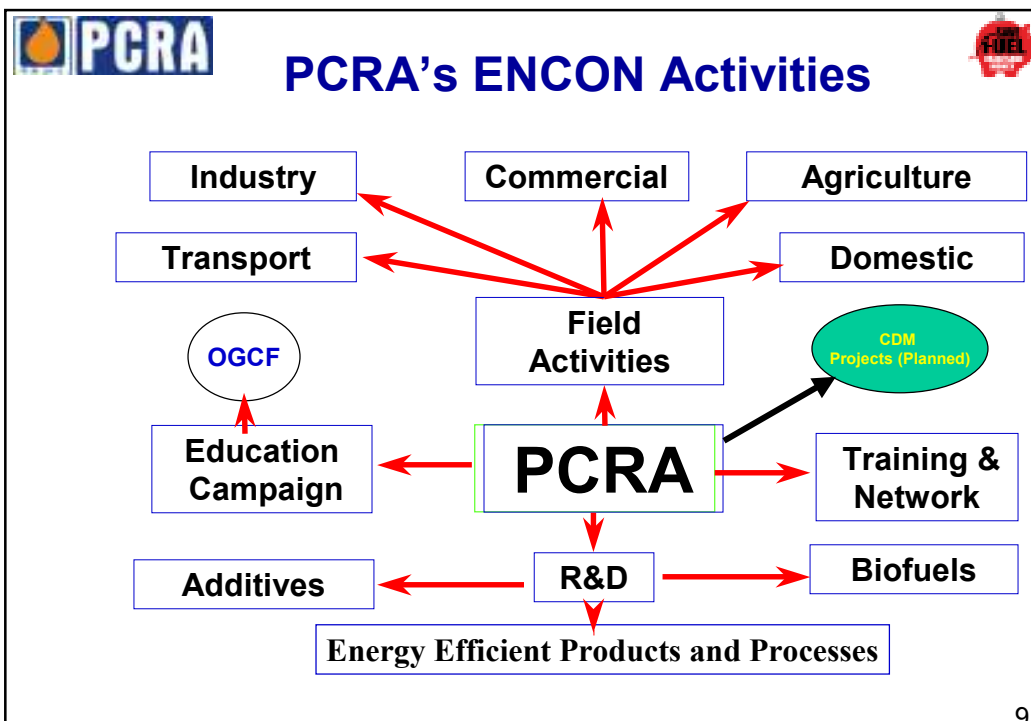
Potential for Energy Saving



- **Total Energy Consumption – 404 MMTOE ***
- **Oil & Gas Consumption – 154 MMTOE ***
- **Potential for saving Energy – 15%**
- **Total Energy Saving Potential – 23 MMTOE**
- **Money Equivalent – Rs.73600 Crores(@ Rs.32000/ ton)**

Hence the need for Conservation

Source : *BP statistical Review, June 2008



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World Racing Ahead

- ❖ China targeting for 20% reduction between 2006 and 2010* !!
- ❖ Energy Policy for Europe(EPE)2007 :20% reduction in energy consumption by 2020
- ❖ Energy consumption levels in Industrial sector in Japan same as 1973 levels**!!!

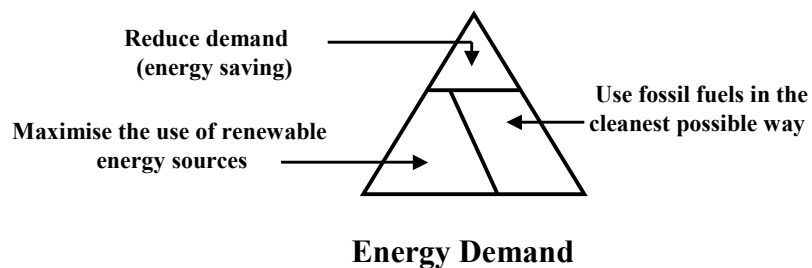
* NDRC Report
 ** IEA Report

The PCRA logo is in the top left, and a small red logo is in the top right.

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- Thrust on Demand side management.
- Maximizing Industrial Energy audits
- Cluster Development
- Replication of Energy audit findings
- R&D for energy efficient product, process and appliances.
- Setting of R&D aided Demonstration Projects
- promotion of CDM & Biofuels
- DTP(Drivers Training program) & MDP(Model depot projects)
- Mass awareness
- Training and Technical Advisory Training and Technical Advisory services to industries.
- Synergistic Institutional Linkages

This three-step approach to meet our energy requirement has been called the trias energetica.



- Energy Audits
- FODS (Fuel Oil Diagnostic Studies)
- Quick short audit
- Follow-ups
- Institutional Training Programs
- Industrial Workshops
- Implementation of Conservation Tips



Case Study

of

Energy Audit

at a

Major Gas Based Petrochemical Complex in India

by

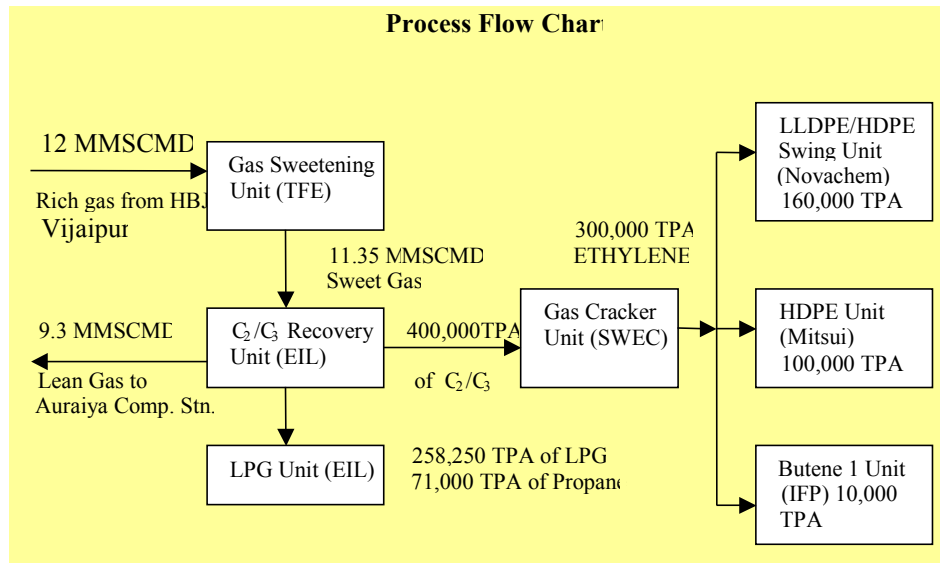
**Petroleum Conservation Research Association
New Delhi**

Salient Features of Plant:

Products manufactured	: LLDPE, HDPE, LPG, Propane, Butene
Installed Capacity	Polyethylene : 2,60,000 TPA LLDPE : 2,10,000 TPA * HDPE : 1,00,000 TPA LPG : 2,58,250 TPA Propane : 71,000 TPA Butene-1 : 10,000 TPA
Turnover	: Rs 18,000 Million per annum
Main raw material used	: Rich Gas

* After debottlenecking, since May, 2004

Process Flow Chart



Energy Consumption



Total Energy Consumption	: 4 Million KL of Oil equivalent
Total Gas Consumption	: 1,034 MMSCM (feed stock + fuel)
Power Requirement	: 263 GWh/Year
Power Generated	: 227 GWh/Year
Power Imported	: 36 GWh/Year
Boiler Water Consumption	: 500 TPH
Total Steam Generated	: 490 TPH (MCR)
Compressed Air Generation	: 19,620 m ³ /hr.



Methodology



- ❖ Pre-audit presentation.
- ❖ Collection of data / information.
- ❖ Measurements and monitoring with instruments.
- ❖ Computation and in-depth analysis.
- ❖ Post-audit presentation to discuss the Energy Conservation Opportunities identified by the audit team.

ELECTRICAL

- Electrical Distribution Network and Transformers (49)
- Motive Loads (131)
- Illumination System
- Air Compressors (2)
Nitrogen Compressors(2)

THERMAL

- Boilers (3)
- Furnaces (4)
- Steam Turbines (2)
- GTs (2) and HRSGs (2)
- PRDS (3)
- Steam Traps (600)
- Steam Distribution
- Thermal Insulation

Steam Turbines

Observation:

- PRDS #1 is used for pressure reduction of steam from VHP to HP.

Recommendation:

- Install back pressure turbine for conversion of VHP to HP steam as well as to generate power, keeping PRDS #1 as standby.

Savings Estimated/Year	Investment	Payback Period
Rs 77.4 Million	Rs 100 Million	16 Months

Observation:

- Leakage / blowing of Steam Traps (45% of 600 nos).

Recommendation:



- Maintenance / replacement of Steam Traps.

Savings Estimated/Year	Investment	Payback Period
Rs 5.9 Million	Rs 1.5 Million	3 Months

Observation:

- During steam balancing, HP (2 TPH) and LP (0.7 TPH) steam could not be accounted for useful utilisation.

Recommendation:

- Calibration of all instruments.
- Install flow meter at PRDS-1 (UB #3), MOP (STG #1 & #2), Steam Ejectors ((STG #1 & #2) & Storage.
- Repair and rectification of all leakages.
- Check steam consumption of turbo prime movers from their design data.
- Conduct Steam Balance Audit once in a quarter.

Furnaces – Blow Down

Observation:

- Blow down losses are varying from 2.5% to 8%.
- Radiation losses are higher in Furnace #2 & #3.



Recommendation:

- Blow down losses to be brought down to 2%.
- Improve insulation of Furnaces.

Savings Estimated/Year	Investment	Payback Period
Rs 3.64 Million	Rs 4.0 Million	14 Months

Gas Turbine & HRSG

Observation:

- High excess air in exhaust of Gas Turbine #2 (286% at $\text{CO}_2 = 3\%$).

Recommendation:

- Improvement in the performance of HRSG-2 by optimising the air quantity in GT #2 ($\text{CO}_2 = 2\%$).



Savings Estimated/Year	Investment	Payback Period
Rs 2.6 Million	NIL	Immediate

Observation:

- Efficiency of UB #1 is 91.36%, UB #2 is 95.79% and UB #3 is 95.9%. The lower efficiency of UB #1 is due to malfunctioning of air modulation system resulting in higher exhaust gas losses of 5.06%.



Recommendation:

- Repair the MOV of FD Fan in UB-1.

Savings Estimated/Year	Investment	Payback Period
Rs 2.45 Million	Rs 0.1 Million	< 1 Month

Observation:

- Heat loss from bare pipe surface near GCU battery.

Recommendation:

- Insulation of pipeline.



Savings Estimated/Year	Investment	Payback Period
Rs 1.19 Million	Rs. 0.02 Million	Immediate

Insulation – Boilers

Observation:

- Heat loss due to damaged insulation in Pent House of UB #1 and UB #2.

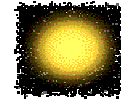


Recommendation:

- Proper thermal insulation for Pent House in UB #1 and UB #2.

Savings Estimated/Year	Investment	Payback Period
Rs 0.62 Million	Rs 0.28 Million	6 Months

Illumination



Observation:

- Conventional tube lights being used for lighting.
- HPSV and HPMV lamps with conventional ballasts are installed in the plant.

Recommendation:

- Replacement of conventional tube lights and chokes with Energy Efficient ones.
- Replacement of conventional ballasts with low loss Electronic Ballasts.

Savings Estimated/Year	Investment	Payback Period
Rs 1.29 Million	Rs 2.1 Million	19 – 20 Months
Rs 1.07 Million	Rs 2.9 Million	32 – 33 Months

Pumps

Observation:

- Cooling Water make-up pump is running at 70% throttled condition.



Recommendation:

- Installation of Variable Frequency Drive.

Savings Estimated/Year	Investment	Payback Period
Rs 1.12 Million	Rs 0.35 Million	4 Months

Motors

Observation:

- 8 motors are operating continuously under - loaded.



Recommendation:

- Replacement / reshuffling with smaller capacity spare motors.

Savings Estimated/Year	Investment	Payback Period
Rs 1.02 Million	Nominal	Immediate

Observation:

- Compressed Air for servicing purpose is supplied at 7 Kg/cm² though requirement is 3-4 Kg/cm².

Recommendation:



- Installation of Transvector Nozzles at the service air points to reduce the CFM requirement by 20%.

Savings Estimated/Year	Investment	Payback Period
Rs 0.99 Million	Rs 0.15 Million	2 Months

Observation:

- Operation of CT Fans done manually.

Recommendation:



- Installation of automatic temperature controller on cooling tower fans of CT-1.

Savings Estimated/Year	Investment	Payback Period
Rs 0.32 Million	Rs 0.06 Million	3 Months

		Saving Potential	
		(KLOE)	(Rs Million)
Thermal	Steam Turbines	1,431.5	77.40
	Steam Traps	1,298.0	5.90
	Furnaces	801.8	3.64
	Gas Turbines & HRSG	572.0	2.60
	Boilers	539.0	2.45
	Insulation	397.3	1.81
Electrical	Illumination	43.6	2.36
	Pumps	20.7	1.12
	Motors	18.8	1.02
	Compressor-Air & Nitrogen	18.4	0.99
	Cooling Tower Fans	5.9	0.32
TOTAL		5,147.0	99.61

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Payback Period	Saving Potential	
	(Rs Million)	(% of total Saving)
Immediate	4.81	4.83
< 1 year	11.40	11.45
b/w 1-2 Years	82.33	82.65
b/w 2-3 Years	1.07	1.08
Total	99.61	100.00

Average Pay Back Period: 14 Months

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Case Study



of

Electrical Energy Audit

at a

Major Indian Refinery

by

Petroleum Conservation Research Association
New Delhi

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ELECTRICAL

Electrical Distribution Network and Transformers

Motive Loads

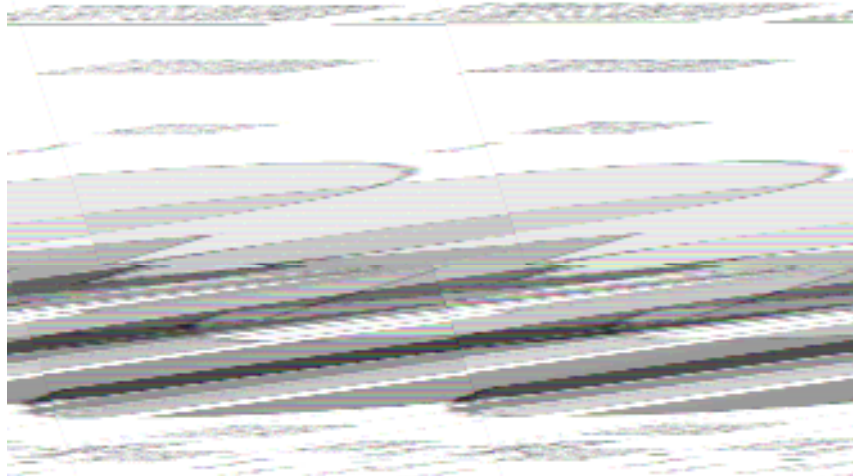
Pumps

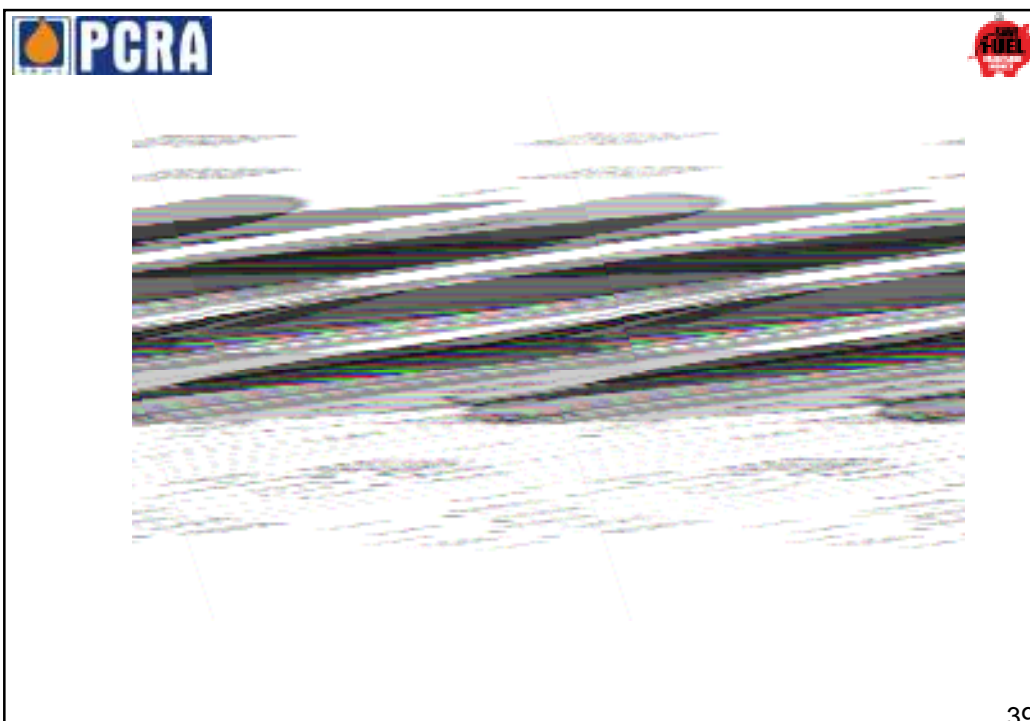
Illumination System

Compressors

Cooling towers

Co Generation Plant etc.





PCGRA **Co-Generation Plant Performance Enhancement**

Observation:

- No Inlet Air Fogging - a low cost technique to boost plant power performance.

Recommendation:

- Install Inlet Air Fogging to avoid dramatic drop in power during summer

Savings Estimated/Year	Investment	Payback Period
Rs 153.5 Million	Rs 28 Million	2 Months

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Operation at Reduced System Frequency

Observation:

- $N \propto \text{Frequency}$. If system frequency reduced to 49.5 Hz, Saving - about 3 % ($1 - 0.99^3$).

Recommendation:

- Majority of the centrifugal pumps and fans in the plant operate at about 80 % or less load. So operate at 49.5 Hz.

Savings Estimated/Year	Investment	Payback Period
Rs 119.2 Million	Nil	Immediate

Automatic Controllers for the Cooling Tower Fans



Observation:

- VFD fan controllers are already installed in one of the cooling tower fans but not in other cooling towers

Recommendation:

- It is suggested to install the VFD controllers on remaining cooling towers also.

Savings Estimated/Year	Investment	Payback Period
Rs 1 Million	Rs 1.5 Million	18 Months

Atmospheric Unit Combined CT Pumps Efficiency

Observation:



- Overall pump efficiency is 55% . The pumps of this rating normally have efficiency of about 85 % and higher.

Recommendation:

- It is suggested to undertake overhauling to improve efficiency.

Savings Estimated/Year	Investment	Payback Period
Rs 51 Million	Rs 5 Million	2 months

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Saving With Chemical Coating

Observation:

- Severe loss of efficiencies may be due to internal damage.

Recommendation:

- Special polymer coating on the pumps internal surfaces and parts reduces surface friction and improves the pumps efficiency.
- It is suggested to undertake special coating.

Savings Estimated/Year	Investment	Payback Period
Rs 3.2 Million	Rs 0.5 Million	2 months

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Observation:

- Overall efficiency of Russian pumps is very low at 41%.

Recommendation:

- Existing pumps may be replaced with more efficient pumps. Scope for saving is high.

Savings Estimated/Year	Investment	Payback Period
Rs 5.2 Million	Rs 1 Million	2 months

Observation:

- The following pumps (FCC-1 nos, CGP – 2 nos, MSQ – 2 nos & Lab – 1 nos) were operating continuously at a lower flow.

Recommendation:

- Installation of VFDs.

Savings Estimated/Year	Investment	Payback Period
Rs 10.8 Million	Rs 2.7 Million	3 months

Observation:

- Output of the compressors reduced and Specific electricity consumption found to be increased.

Recommendation:

- Overhaul all three compressors to operate at the specific consumption of about 18 KW/100SCFM & reduce total load.

Savings Estimated/Year	Investment	Payback Period
Rs 14.4 Million	Nominal	Immediate

Observation:

- Supply voltage is at 245 to 252 Volt. Luminaries are rated for 230 Volt. 10% higher voltages, lamp lumens up by 5% & power also up by 10% to 15%. Life also decreases at higher voltage.

Recommendation:

- It is suggested to change the tap to output voltage of about 380 Volts by installing 'Lighting Energy Saving Device'.

Savings Estimated/Year	Investment	Payback Period
Rs 3.3 Million	Rs 1.9 Million	7 Months

 **Relocating the Lighting Fixtures** 

Observation:

- Lighting fixtures located on the trusses in the compressor shed.

Recommendation:

- It is suggested to relocate the fixtures on the sides at a height of 10 meter. In 6.6 KV air compressor house, the 400 W HPMV lighting fixtures are to be replaced by 250 W MH lamps

Savings Estimated/Year	Investment	Payback Period
Rs 0.51 Million	Rs 0.28 Million	7 Months

 **Energy Conservation Opportunities**  

Equipment	Saving Potential	Investment	Pay Back Period
	(Rs Million)	(Rs Million)	Months
Co-Gen Plant	153.50	28.00	2
Electrical Network	119.20	NIL	Immediate
Cooling Tower Fans	1.00	1.50	18
Pumps	70.20	9.20	2
Compressors	14.40	Nominal	Immediate
Illumination	3.81	2.18	7
TOTAL	362.11	40.88	< 2

(Based on PwC Report)

Activity	Recurring Saving Realized due to PCRA activities (KLOE) since 2005-06			
	2005-06	2006-07	2007-08	2008-09
Energy Audits	6,996	20,701	51,205	64,319
Fuel Oil Diagnostic Studies	1,483	2,358	7,380	9,005
Driver Training Programme	45,443	83,586	1,15,784	2,78,380
Model Depot Project	32,028	42,704	56,292	73,924
Research & Development	1,392	2,784	5,201	7,618
Total (KLOE)	87,342	1,52,133	2,35,862	4,33,246
Total Value (Rs. Crores) @ Rs. 30,000/- per KLOE	262	456	708	909



धन्यवाद