Reliance Industries Limited
Hazira Manufacturing Division

Unit Profile:

Reliance Industries Limited was founded by Sh. Dhirubhai Ambani (1932-2002) in the year 1977. Now, Shri Mukesh Ambani, Chairman and Managing Director is steering the company. Under their visionary leadership, the Reliance Group emerged as the largest business conglomerate in India. RIL ranks amongst the World's Top 200 companies in terms of profits. In terms of growth, RIL found place in the elite world's top 25 climbers in the Fortune Global 500 companies. The current Global ranks and change in rank over 2004 is shown in Fig-1.1

RIL is organized in 3 major business s segments viz Exploration and Production of oil & Gas, Refining/marketing of petroleum products, Petrochemicals, including manufacturing & marketing of Polymer, Polyester, Polyester intermediates, Chemicals

It has major production facilities at Hazira, Jamnagar, Naroda and Patalganga. RIL also has Oil & Gas exploration and production interests in India, Yemen and Oman.

With vertical integration of its chain products from Refinery to Textiles, RIL is perhaps the only corporate entity in the world to be integrated in the entire value chain added chain from oil production to retailing of textiles. RIL continues to be India's largest exporter, reflecting its global competitiveness, international quality of its products and superior logistical capabilities. In 2006-07, Reliance has recorded a gross turnover of 118,354 crores and a net profit of Rs 11,943 crores (US$ 2,747 million). The company's total assets are valued at Rs 117,353 crores. Reliance is amongst top 10 producers globally of all its major products.

This application report pertains to Hazira Manufacturing Division of Reliance - India's largest Petrochemicals and Polymers complex. Hazira site, spread over 1000 acre, is located 22 kms west of Surat city in Gujarat State on the estuary of Tapi river contributing almost 20% to RIL's total turnover and has >24% contribution to RIL's PBDITA.

It is a multi-product, fully integrated complex manufacturing a wide range of Polymers, Polyesters, polyester intermediates and petrochemicals. Hazira complex began with land filling in July 1989 (first pile was driven in December 1989) and was established mainly in two phases during 1991-1997 for production of Polymers, Fibres and Intermediates.

Hazira has five ships (one ocean going tanker and four ocean going vessels for liquefied gas), five tugs, three jetties and one SPM, all these necessitated to bring in Raw material to Hazira complex.

Manufacturing Facilities at Hazira

Naphtha is cracked at high temperature to produce ethylene and propylene. Benzene and toluene are extracted from the cracked products. Recently commissioned Butadiene plant adds value to the C4 stream from cracker. 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 350 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 remot location.

(ii) Energy Consumption:

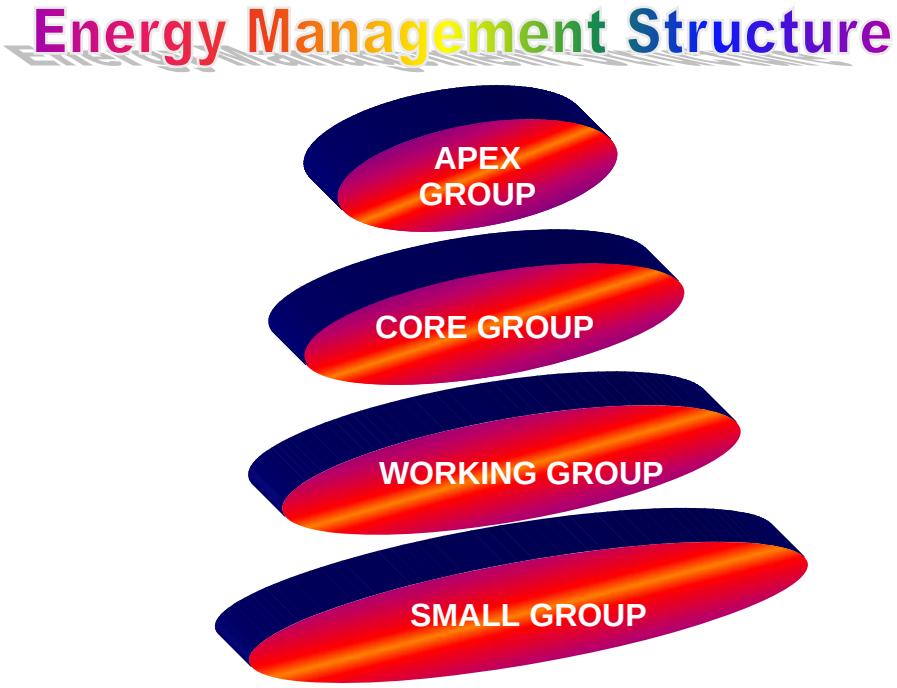
Drooping trend of energy consumption is the result of energy conservation efforts put-forth by RIL Hazira team. Data for the past three years is mentioned below.

Description	Unit	Year		
		2004-05	2005-06	2006-07
Annual Production	MT	5585260	6028000	6739000
Electrical Energy Consumption	Lakh kWh	18706	19431	22265
Thermal Energy Consumption	Mmkcal	7627549	8122391	8306554
Specific Electrical energy consumption	kWh/MT	335	322	330
Specific Thermal Energy Consumption	M kcal/MT	1.366	1.347	1.233
Overall Specific Energy Consumption	Mkcal/MT	2.00	1.88	1.84
Energy Cost/ Manufacturing Cost	%	19.3	14.3	11.8

iii) Energy Conservation Commitment, Policy & Set-up:

* To intensify the in-house efforts for improving Energy Efficiency separate Energy Cell was created in June ‘99
* Energy policy has been revised in March – 2007, the major change is to recognize the impact on environment and to express commitment to minimize the effect. Reliance’s energy policy has been attached as annex – C.

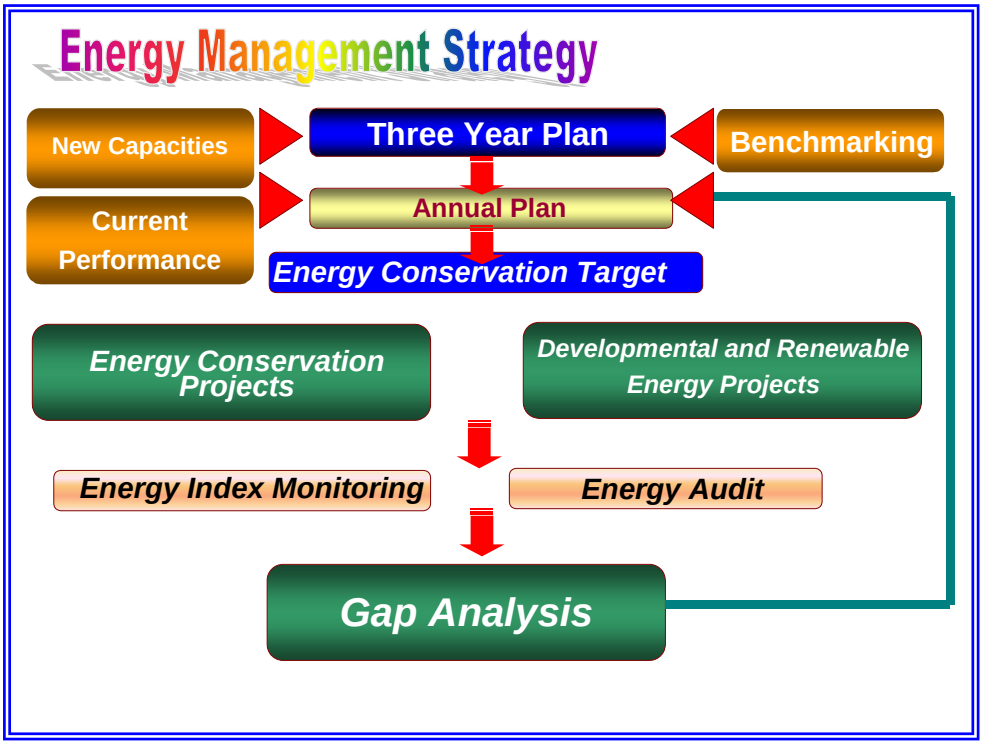
Four Tier Energy Management System is followed at Hazira

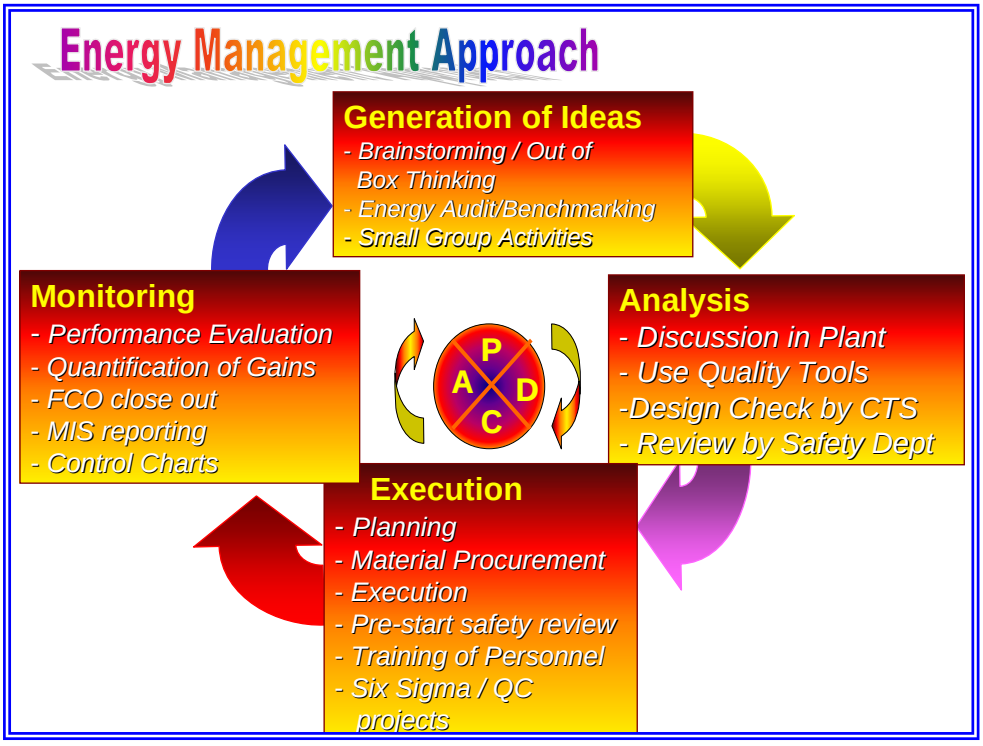


* The **Apex Group** comprises of primarily the top management at RIL Hazira. The Executive Director (Hazira Site) heads this group.
* Energy Cell is headed by Vice president. He has 4 engineers working with him. This is the **Core Group**.
* Each of the plants has a designated Energy Co-coordinator. 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 • Sr. Vice President – CTS • Vice President - EFC • Sr. Vice President – Mfg. • VP - Olefins • VP – CPP & U • VP - Electrical • VP – Fiber • Certified Energy Managers	> Review complex energy consumption trend. > Review status of schemes. > Major decision making for implementation & continued improvements
Core Group	• Sr. Vice President – CTS • Vice President – E & FC • Managers – 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. > 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 co-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, mechanical and Instruments • Cross functional team of managerial staff	> Brain storming. > Identification of theme on energy conservation. > Study the system w.r.t energy. > Implementation of energy efficiency projects.

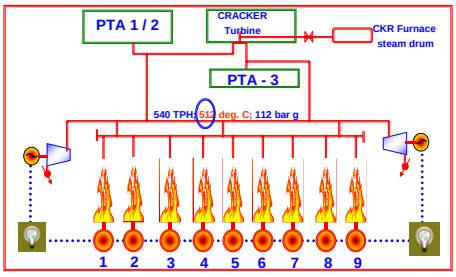

Energy Management Strategy
New Capacities
Current Performance
Three Year Plan
Annual Plan
Energy Conservation Target
Benchmarking
Energy Conservation Projects
Developmental and Renewable Energy Projects
Energy Index Monitoring
Energy Audit
Gap Analysis


Energy Management Approach
Generation of Ideas
- Brainstorming / Out of Box Thinking
- Energy Audit/Benchmarking
- Small Group Activities
Analysis
- Discussion in Plant
- Use Quality Tools
-Design Check by CTS
- Review by Safety Dept
Execution
- Planning
- Material Procurement
- Execution
- Pre-start safety review
- Training of Personnel
- Six Sigma / QC projects
Monitoring
- Performance Evaluation
- Quantification of Gains
- FCO close out
- MIS reporting
- Control Charts
P
D
C
A

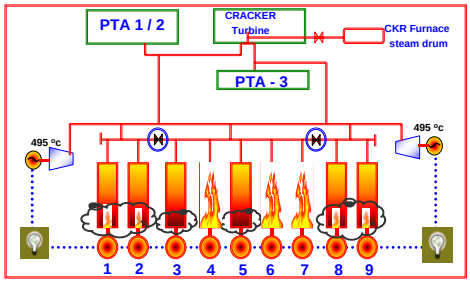
Energy conservation Achievements:

1. *SHP steam temperature optimization by segregation of header*

[Savings: Rs. 1932 lacs p.a.]



At RIL – Hz, SSHP steam is generated through 9 nos. HRSGs. The steam is supplied to various consumers like CPP – Steam turbines, Cracker – steam turbines and PTA plants. The entire header was maintained at 510 deg. C temperature at 110 kg/cm^2 g pressure leading to excess steam generation which had to be condensed in steam turbine for power generation leading over all sub optimal operation of CPP. In order to improve upon the efficiency of CPP operations the idea of SSHP header segregation has been conceived. The final temperature requirements at all the consumers have been studied. It was brought out by the study that STGs in CPP require only 485 deg. C temperature. The re-wheeled turbines at the cracker end requires only 494 deg. C temperature. PTA plant can tolerate 480 deg. C temperatures. Thus the temperature of 510 deg. C has been optimized to 500 deg. C at CPP end. The SSHP header segregated by closing selected isolation valves for supplying steams from HRSG # 1,2 to STG – 1 and steam from HRSG -# 8,9 to STG #2. This measure led to minimum supplementary firing in HRSG # 1,2,7 and 8. Cracker and PTA has been supplied through HRSG #3,4,5,6 and 7. Using turndown capacity of HRSG # 3,4,5,6 and 7 – supplementary firing in 2 nos. HRSGs have been stopped. Thus the total SSHP steam generation was reduced to the tune of 31 TPH



2. *Utilisation of vent steam from PTA-3 to cracker and CPP*

[Savings: Rs. 1235 lacs p.a.]

Background:

- PTA-3 generates 3.5 kg/cm^2 g steam in E3-304 (First Reactor Condenser) . The steam, as per design, is expected to be fully utilized in the plant in exchangers and turbine of PAC train.
- As per design, the surplus power in PAC train would be exported to RIL grid through motor / generator arrangement in the train.
- In actual, the plant was **generating excess steam than design in their process** and the steam input to the PAC turbine was limited by the total Power generated, necessitating steam venting on header pressure control.
- In August'06, at higher plant throughput**,** it was estimated that ~ 25 TPH of 3.5 kg/cm^2 g steam was being vented resulting in loss of energy/material (DM Water).

Brief Description of Proposed change:

Various cost benefit options were evaluated and it was finally recommended to utilize surplus 3.5 kg/cm^2 g steam based on trials and process calculations:

1. **Cracker:** Cracker has a 3.5 kg/cm^2 g header, with a consumption of ~ 55 TPH at this level. Then, the requirement was being met by :
2.
   a. Let down from OSBL 4.5 kg/cm^2 g header (~30TPH)
   b. Let down from cracker ISBL 12 kg/cm^2 g header. (~ 25 TPH)

The above usage of ~ 15 TPH could be substituted by 3.5 kg/cm^2 g steam of PTA-3

3. **CPP** : Deaerators in CPP consume LP steam (0.8 to 1.5 kg/cm^2 g) which can also be substituted by ~ 10 TPH of 3.5 kg/cm^2 g source of PTA-3 in Deaeartor # 1&2 or Deaerator # 4

Thus a total of 25 TPH of 3.5 kg/cm^2 g steam from PTA-3 could be utilized with the available 18" LP steam header in OSBL and at the supply pressure of PTA-3.

3. *Make-up Water heater installation in HRSG # 3,4,7*

[Savings: Rs. 889 lacs p.a.]

At RIL Hazira, from Gas Turbines exhaust gases, high pressure steam is generated through Heat Recovery Steam Generator (HRSG). In BHEL HRSGs the stack temperature used to remain ~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. Therefore it was found that the stack temperature can be safely brought down to 145°C safely.

Various options for heat recovery were worked out,

1) Furnace /boiler air pre-heating
2) Water Preheating
3) Direct LP steam generation for using in
   a. Vapor Absorption Machine
   b. De-aerator
   c. Meeting Process Requirement
   d. Injection in steam turbine for power generation.

Option for preheating the feed water to De-aerator found to be most efficient and economical.

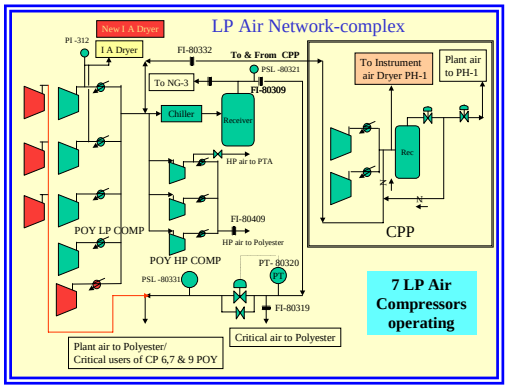
Design Considerations for Make up water heater

1) Stainless steel modules to protect from acid corrosion
2) 3-way control valve for bypassing the water, when stack temperature start coming down below 145°C
3) Designing the module for complete dry running
4) PSV at outlet to avoid pressurization due to accidental steaming
5) Within small available space , design optimized to accommodate two rows of module with SS fins
6) Total heating surface 3250 SQM

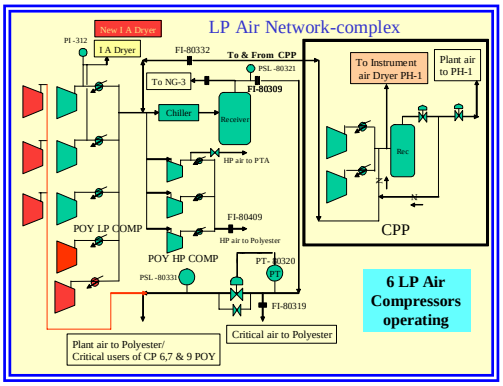
Three nos. make-u water heaters have been installed in HRSGs #3,4 and 7 during the year 2006-07.

- Set points were matched to minimize Unloading valve openings in POY LP air Compressors.
- Minimum amperage settings revised from 212 to 196 amps in CPP compressors and

4. *Optimisation of plant air compressor operations* *[Savings: Rs. 265 lacs p.a.]*



There are 9 nos. LP air compressors installed in the complex, of which now 7 nos. were operating on a continuous basis to maintain the header pressure after the expansion projects CP-10 & CP-11. A study was initiated to optimize number of LP air compressors operating at CPP, POY & CP-10/11: Based on the margins in new and old compressors in POY, following was done.



- Set points were matched to minimize Unloading valve openings in POY LP air Compressors.
- Minimum amperage settings revised from 212 to 196 amps in CPP compressors and
- Discharge set point revised to unload 2 POY compressors based on their actual performance

A s a result, the margins in the system were created and with the normal demand, One LP air compressor was stopped after the above changes saving 1.3 MW. Today, the complex demand is being met with 6 no. of LP air compressors.

Apart from Energy conservation initiatives mentioned above Reliance – Hazira has demonstrated its commitment towards energy conservation through choice of energy efficient technologies through following technology absorption.

a) Installation and commissioning of power recovery train as part of new PTA plant commissioning leading the power generation by waste steam. The conventional PTA technologies consume about 12 MW of power in its Process Air Compressor while the new technology employed by RIL – Hz exports power to the tune of 6 MW off loading the power demand from Captive power plant.

b) RIL – Hz has commissioned one of its largest cooling tower with the circulation of 30,000 m^3/hr in the year 2006-07 as part of PTA – 3 project using counter current cooling tower technology. The new technology though brought out many technical challenges including the sustainability of PVC fills and pump suction related issues, Reliance – Hz has implemented the technology using the sump modeling

exercise. Reliance – Hz has demonstrated its commitment to the concept of 'Energy Modesty' by segregation of LP and HP cooling water pumps at the design stage itself. This initiative resulted in the total power savings of 79.6 lacs KWH per annum.

In addition to the energy conservation – retrofit projects, RIL – Hz has taken following special initiatives for enhancing its contribution towards the ***sustainable development***.

a) Clean Development Mechanism

RIL – Hz has registered first ever CDM project from the Reliance group of companies under The Kyoto protocol in the month of April '06. The project has been registered with UNFCCC based on its uniqueness and innovativeness. The first cycle of project verification for the period April '04 to July '06 has yielded 56,119 CERs in the month of June '07.

As a major step towards the reduction of GHG emission, RIL – Hz has switched over its complete operations from liquid fuels to the Natural gas since April '05. The seamless change over on the gaseous fuel has substantially reduced the specific CO_2 generation from about 0.51 MT of CO_2 / MT of production in the year 2004-05 to 0.40 MT of CO_2 / MT of the production in the year 2005-06.

Reliance – Hz has plants to develop two more CDM projects in the year 2007 - 08.

b) Non- conventional / Renewable energy sources

RIL – Hz has initiated the usage of renewable energy sources before a long ago by installation and successful operation of bio gas recovery plant from PTA plant effluent. This was the first of its kind recovery plant for PTA effluent treatment. Along with the commissioning of its 3rd PTA plant in 2006-07, RIL – Hz has taken the opportunity to select upgraded bio-gas recovery technology. The three competing technologies viz. hybrid reactors, Up flow Anaerobic Sludge Blanket (UASB) and Internal Circulation (IC) has been studied in detail. At the end of the evaluation, Reliance Hazira has selected UASB technology in spite of its higher operating cost, higher area requirements, granular sludge requirement, vulnerability to shock loads and higher start-up time, entirely on the merit of higher biogas recovery through COD reduction. The plant has been commissioned and stabilized in the year 2006-07 along with the commissioning of PTA - 3 plant.

RIL – Hz has initiated efforts to harness natural convection and wind energy for ventilation by installation of **"ECO VENTILATORS**" for hot air exhaust. During the year 2006-07 total 81 eco ventilators have been installed at various locations including central workshop.

In order to further progress in its commitment towards maximizing the usage of non-conventional energy sources, RIL – HZ has installed solar power based telephone exchange at its township. The system is under commissioning. RIL – Hz has plan to convert its raw water pump house consuming 540 KW power on solar power based pumping house.