NTPC Ltd...

Striving for Greener Future

Presentation Outline

- NTPC .... a brief overview
- Performance Highlights
- Power perspectives
  - Energy Efficiency
  - Technologies for Clean energy production
  - Environment Management
  - Renewable Energy
  - PIE.... Efficiency-improvement strategy promising success
- CenPEEP
- O & M : Gearing up for future challenges
- Conclusion

NTPC Ltd .... Overview

NTPC - Vision and Mission

Our Vision

A world class integrated power major, powering India's growth, with increasing global presence

Our Mission

Develop and provide reliable power, related products and services at competitive prices, integrating multiple energy sources with innovative and eco-friendly technologies and contribute to society"

NTPC- Today

Business

- The largest power generation company in India, with comprehensive in-house capabilities in building and operating power projects
- Current operating capacity – 28,644 MW (including JV)
- 18 coal based (23209 MW) and 8 gas based (5435 MW) power plants
- Setting up hydro based power plants (2471 MW under implementation)
- Developing coal mines for captive use (47 mtpa by 2017)
- Exploring oil / gas blocks in consortium with partners
- Subsidiary & JV companies for taking up generation, power trading, distribution business and for setting up of small hydro plants (<250 MW)
- Plans to become 50,000 + MW company by 2012

NTPC- Today

Size

- ONE OF THE LARGEST INDIAN COMPANIES WITH A MARKET CAP OF MORE THAN US$ 50 BILLION
- HAS A NET WORTH OF AROUND US$ 13 BILLION
- HAS TOTAL ASSETS OF AROUND US$ 20 BILLION

Stature

- THE LARGEST GENERATOR IN INDIA WITH 20% OF INSTALLED CAPACITY & 28% GENERATION OF THE COUNTRY
- NTPC COAL BASED UNIT PLF FOR 06-07 WAS 89.43 AGAINST ALL INDIA PLF OF 76.8. AVAILABILITY FACTOR FOR NTPC WAS 90.1%
- 494TH LARGEST COMPANY IN THE WORLD: 6TH LARGEST UTILITY IN ASIA (FORBES RANKING – 2006)
- PLATTS HAS RANKED NTPC AS NO. 1 INDEPENDENT POWER PRODUCER COMPANY IN ASIA, 2007.

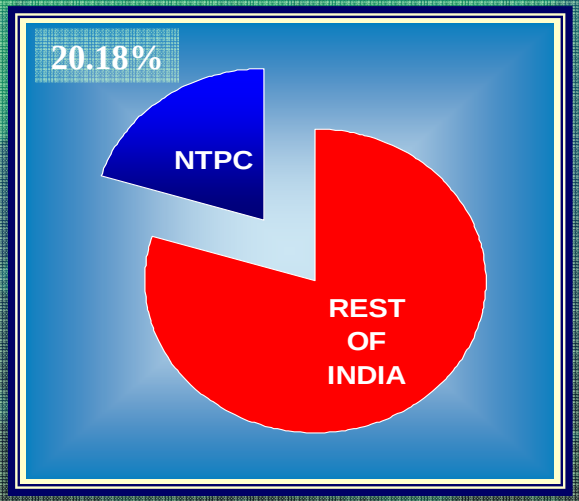
Ownership

- GOVERNMENT HAS 89.5% STAKE
- 10.5% WITH PUBLIC

Business strength - Market Share

TOTAL CAPACITY AS ON 31.03.2007

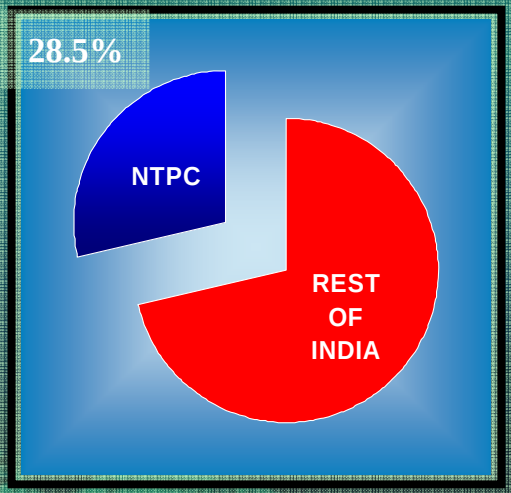
NTPC 26350* MW - 20.18 % of All India 130,539 MW



* excluding JVs

GENERATION 2006-07

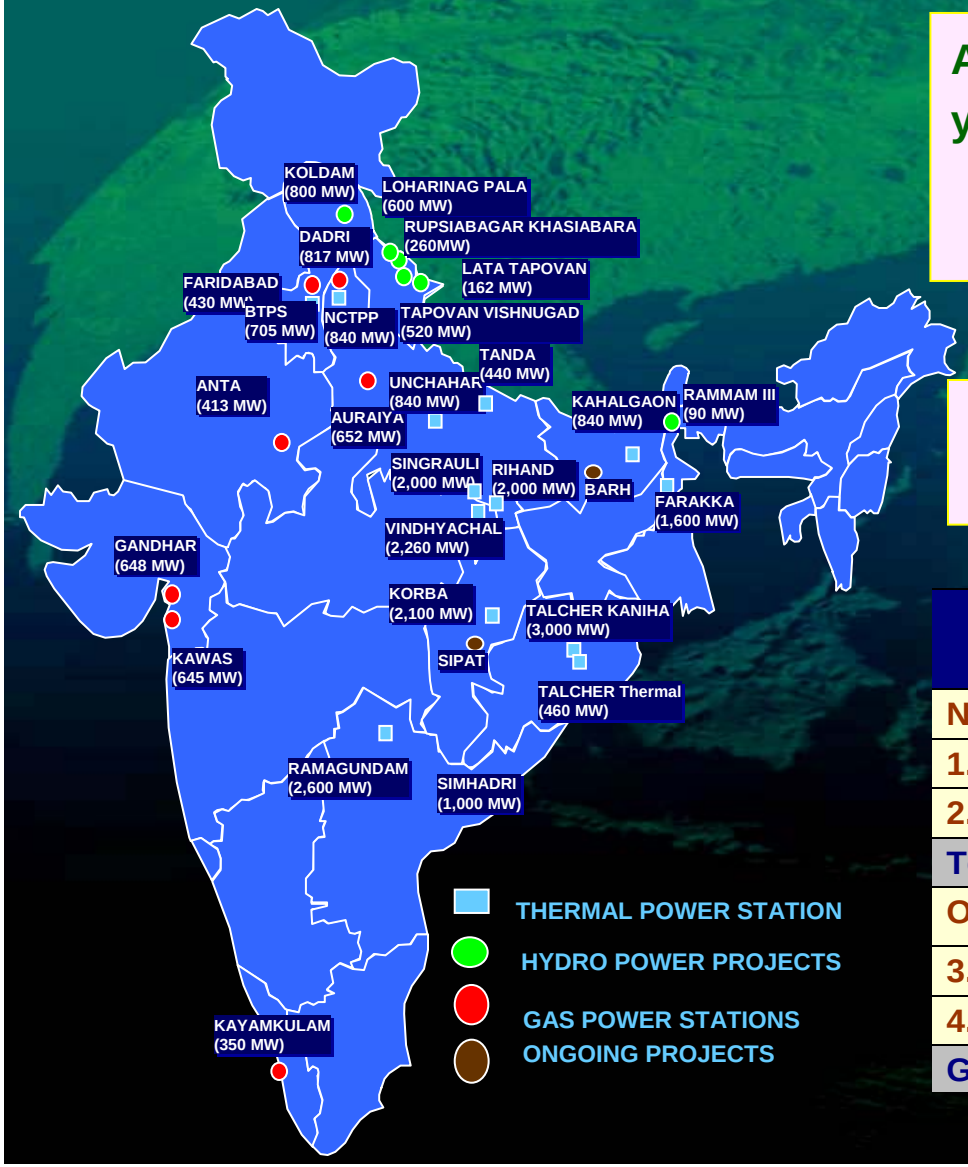
NTPC 188.67* BUs - 28.5 % of All India 662.43 BUs



* excluding generation from JV companies

- MORE THAN ONE-FOURTH OF INDIA'S GENERATION WITH ONE-FIFTH CAPACITY
- THE NEXT LARGEST POWER UTILITY OWNS 7.9% OF MARKET SHARE IN TERMS OF CAPACITY AND 8.12% OF SHARE IN TERMS OF UNITS GENERATED

Unmatched Competitive Position - Supplier to all major states



As per Forbes Global 2000 ranking for the year 2005, NTPC ranks:

- **463rd biggest company in the World**
- **5th biggest Indian company**

As per ADB's Memorandum, NTPC is:

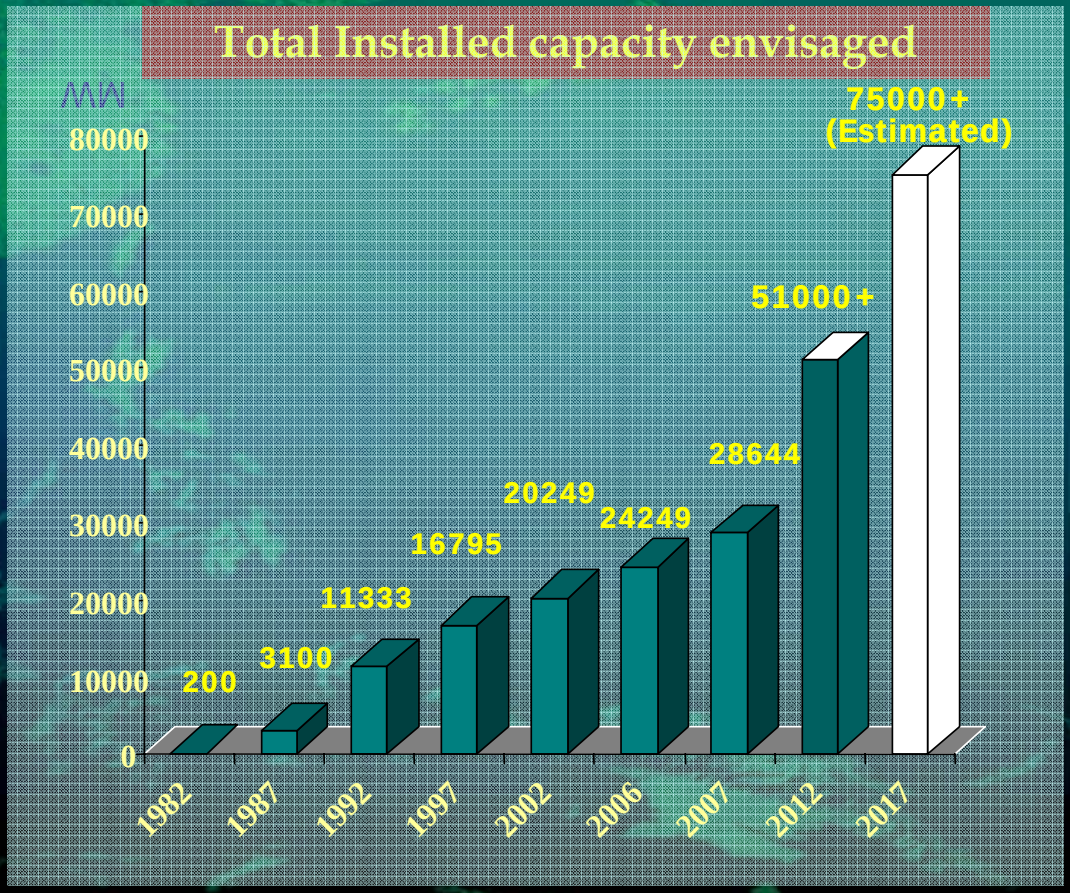
- **2nd Largest Asian Power Generator.**

	No of plants	Capacity (MW)
NTPC Owned		
1. Coal	14	22895
2. Gas / Liquid Fuel	7	3,955
Total	21	26850
Owned by Joint Ventures		
3. Coal	3	314
4. Gas / Liquid Fuel	1	1480
Grand Total	25	28644

Capacity Addition Programme

Growth Strategy

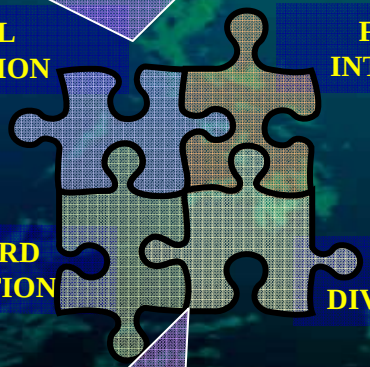
- Multi pronged approach to capacity addition
  - Greenfield projects
  - Brownfield expansion
  - Joint ventures / Acquisitions
- Diversification in related business areas
  - Hydro projects
  - Coal Mining
  - Power trading
  - Oil / gas exploration
  - LNG value chain
  - Consultancy services



Capacities under execution – 13,860 MW

NTPC investment plan for the period 2007-2012: USD 40 Billion

NTPC Going Forward



LATERAL INTEGRATION

- Hydel Power ~9,000 MW by 2017
- Nuclear Power 2000 MW by 2017
- Non-conventional 1000 MW by 2017

FORWARD INTEGRATION

- Globalization
  - Setting up of power plants abroad
  - International Consultancy

- Power trading
- Power Distribution

BACKWARD INTEGRATION

- Seven coal mine blocks (~47 MTPA cap.) allocated
- One oil/gas block allocated.
- NTPC requirement for gas ~ 5 MTPA by 2010

RELATED DIVERSIFICATION

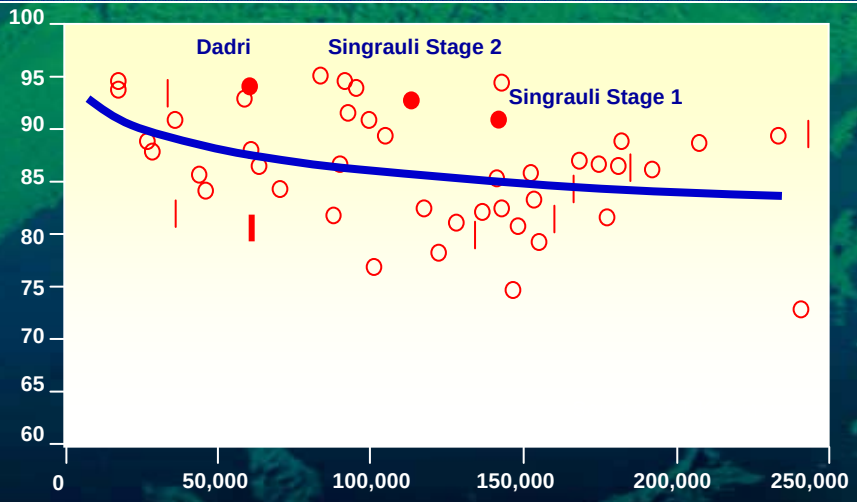
- Sectoral Support
  - PIE
  - APDRP
  - Rural Electrification
  - Training under DRUM

- R&M of power stations
- JV for Captive Power

NTPC .... Performance Highlights

Operational Performance

NTPC Availability Levels



Environmental Focus

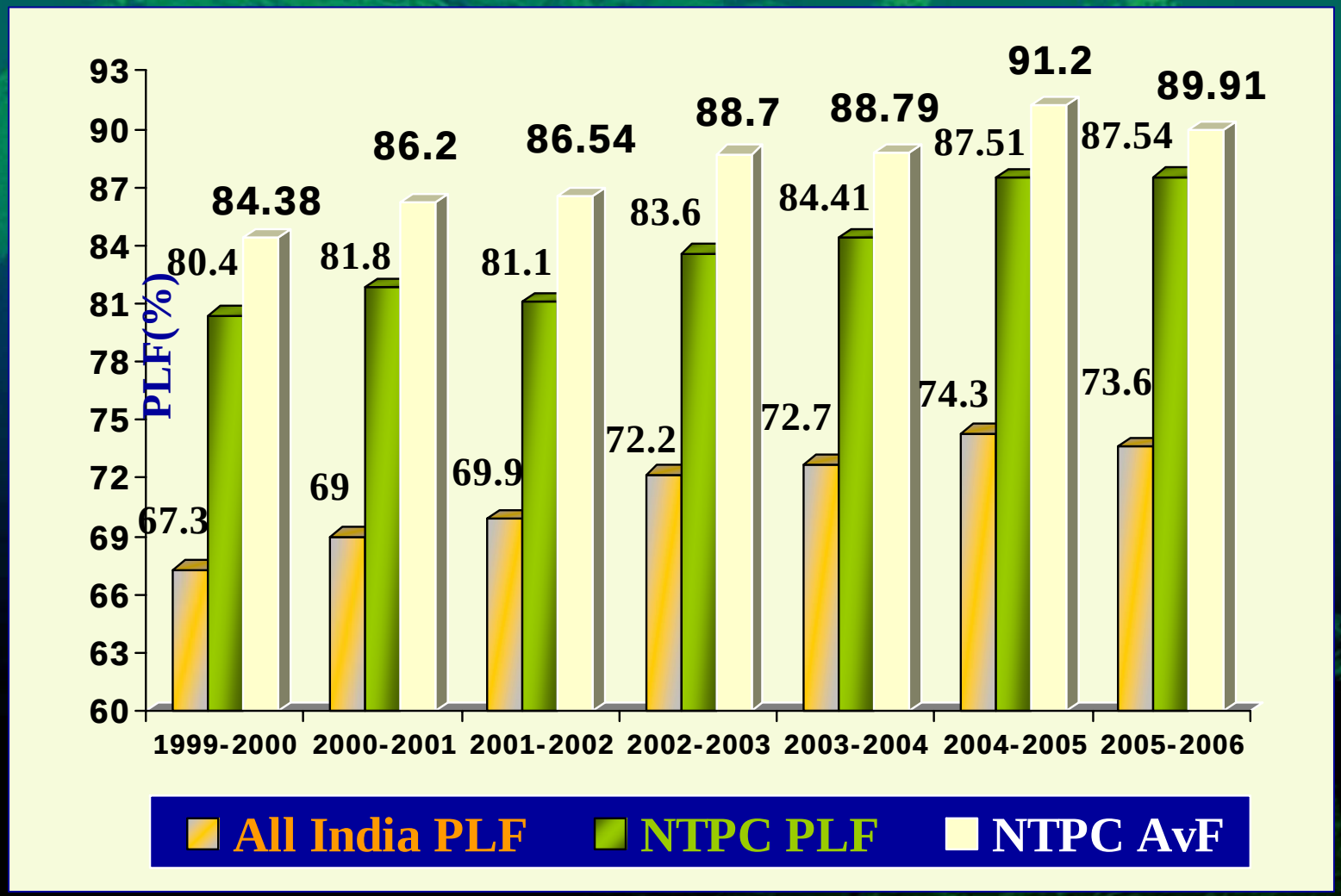
- World's largest ESPs used by NTPC
- Environmental monitoring emphasis
- Efforts to increase Energy efficiency

NTPC stations are regular recipients of CEA's meritorious performance awards.

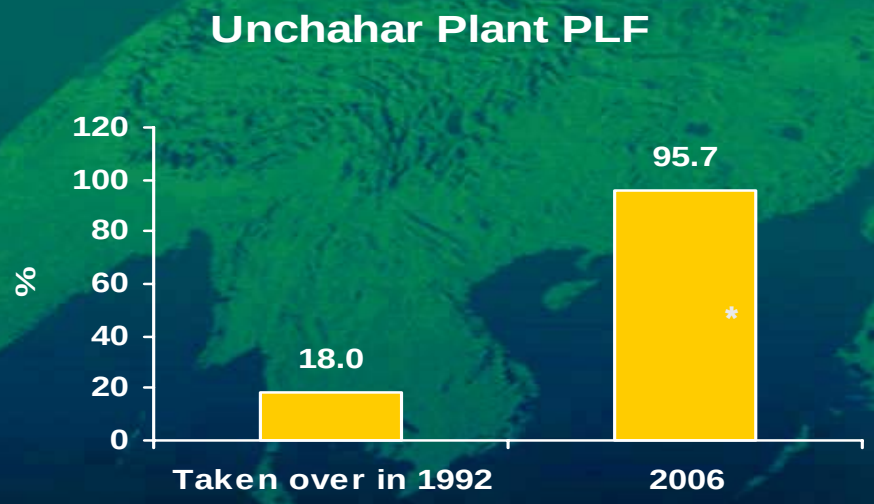
12 NTPC Stations achieved PLF of above 85% during 2005-06, 3 of these stations achieved PLF of above 90%.

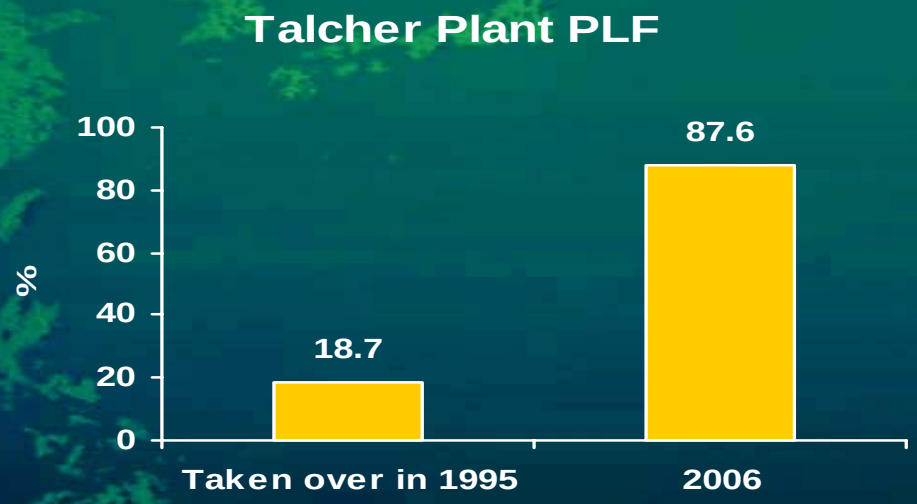
11 NTPC Stations amongst top 20 in the country in 2005-06 including 3 taken over plants.

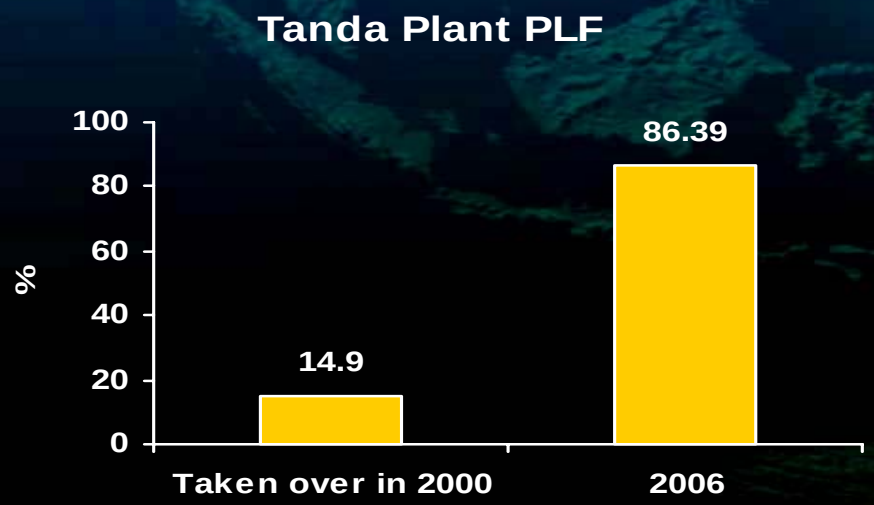
High Capacity Utilization (PLF)

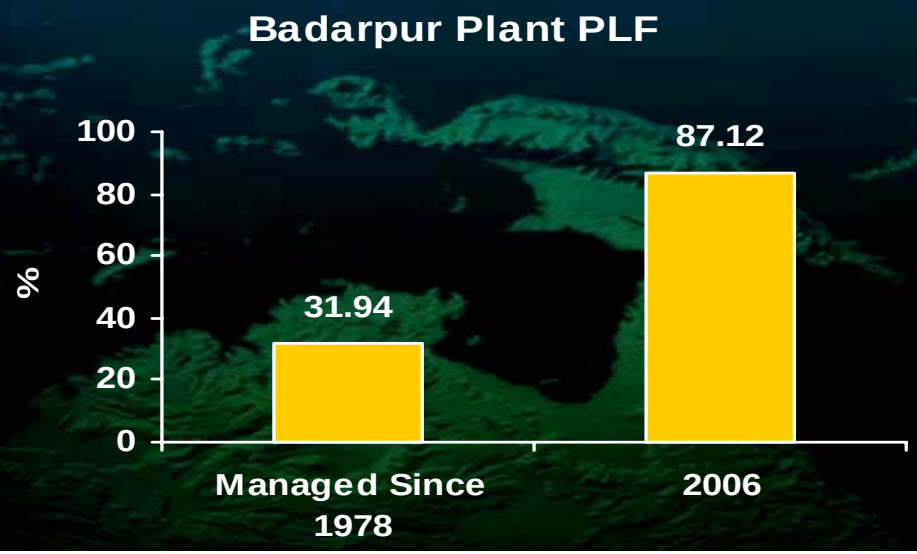


Turnaround Capability

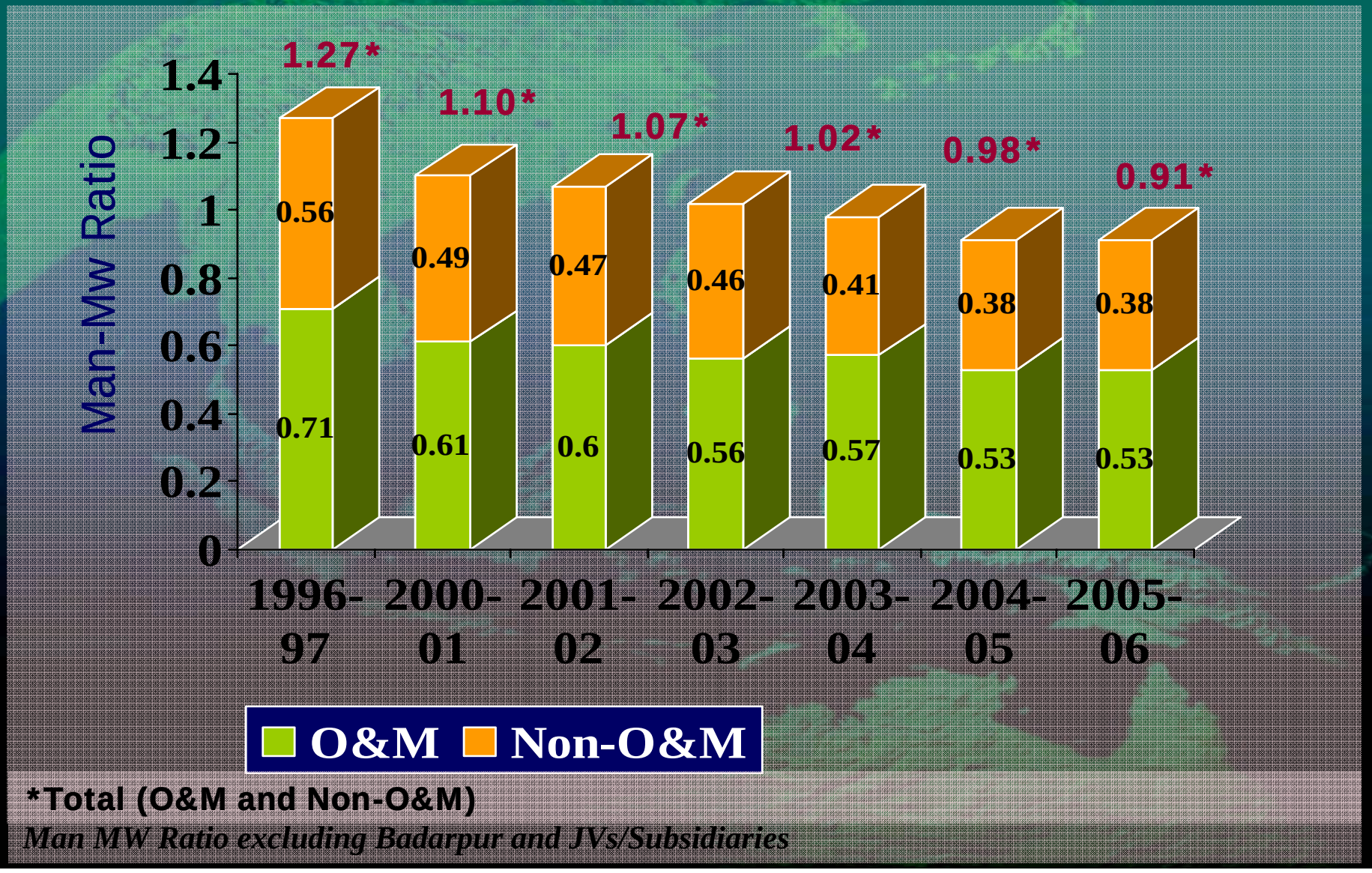








Man-Mw Ratio Over the Years



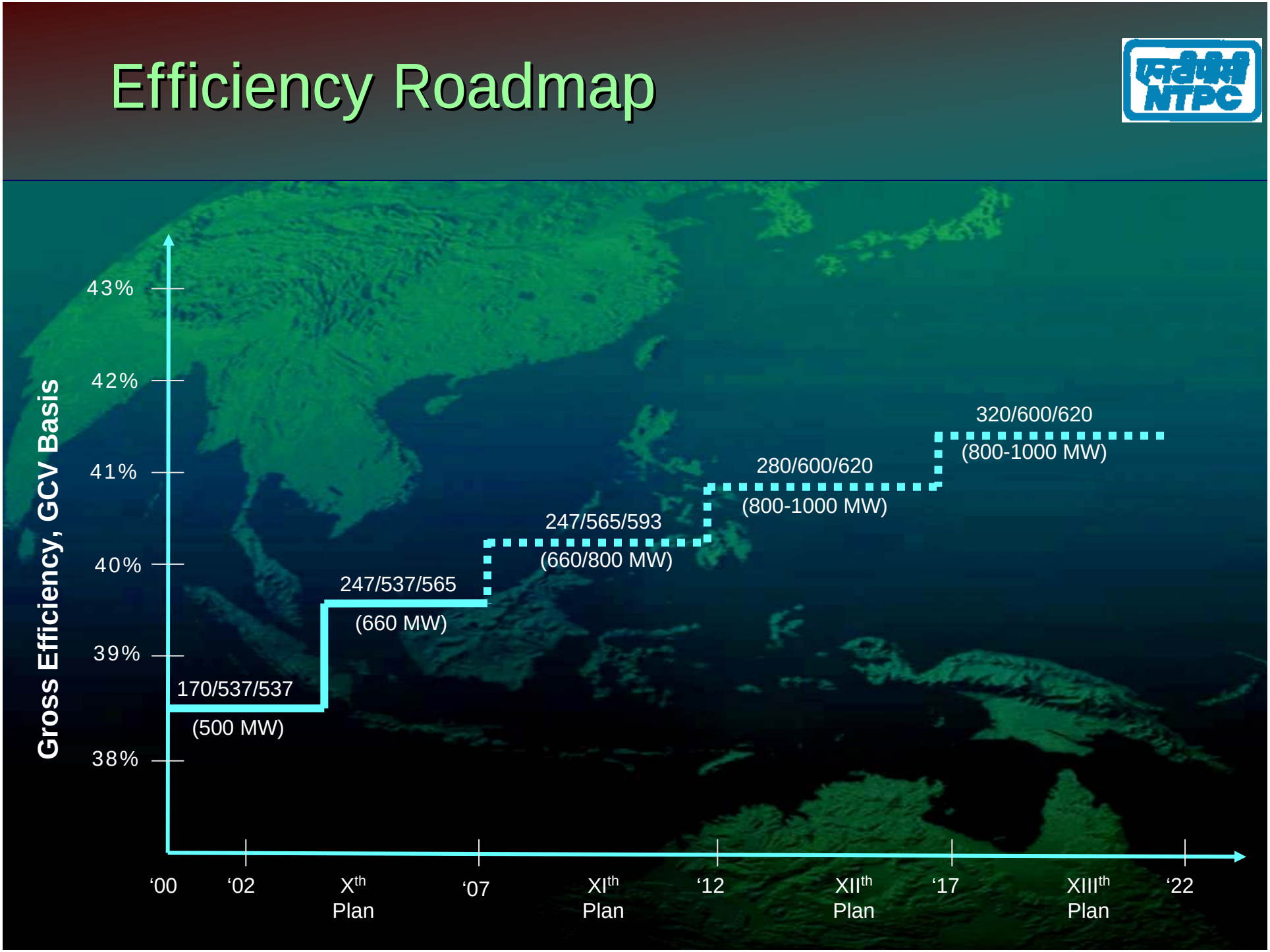
*Total (O&M and Non-O&M)

Man MW Ratio excluding Badarpur and JVs/Subsidiaries

Energy Efficiency

Setting the Scene today for a future-oriented Sustainable Energy production

Efficiency Roadmap



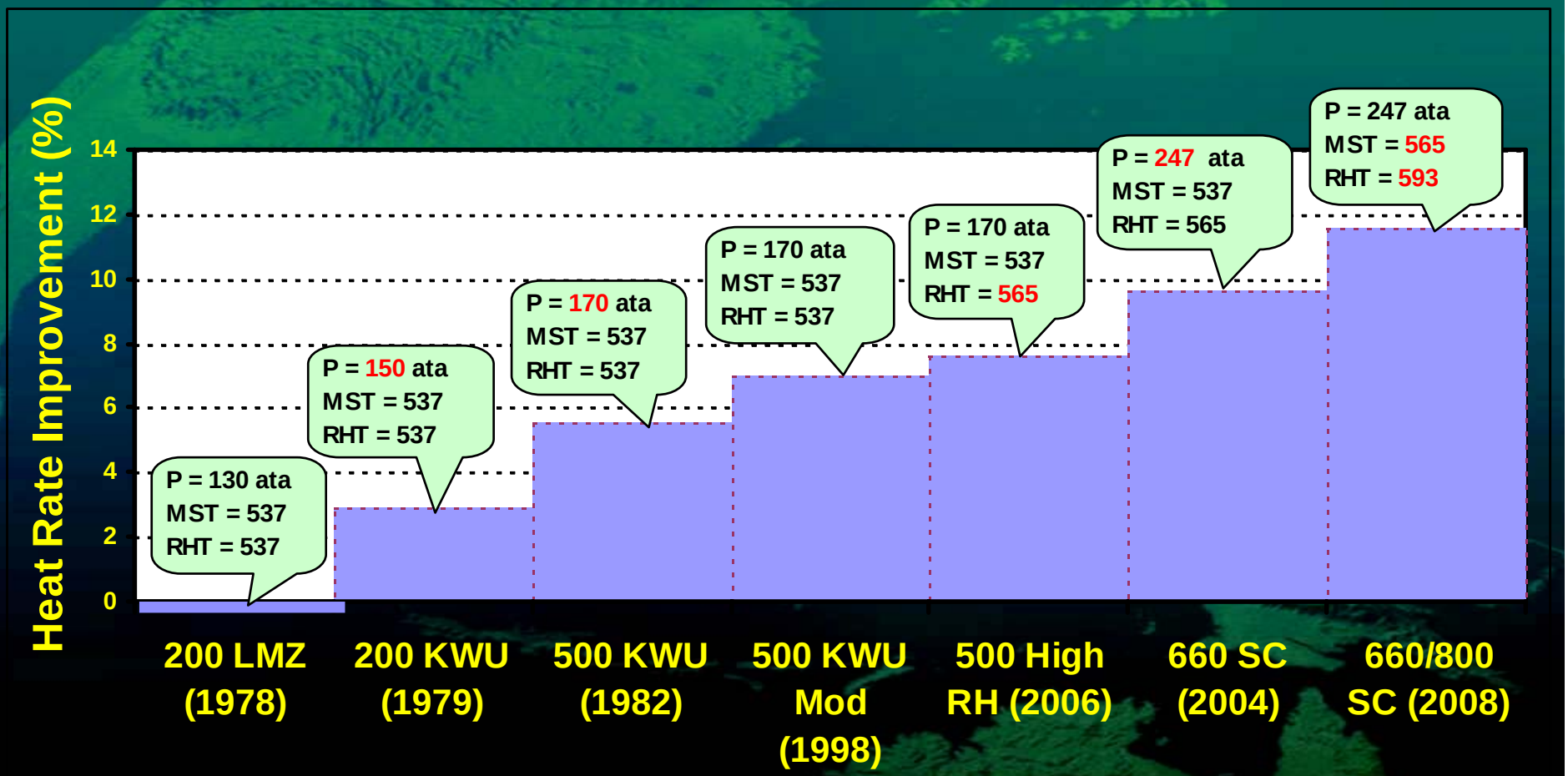
Lower Plant Efficiency in India

The reported efficiency of Indian power plants is generally lower as compared to efficiency of plants abroad, primarily due to

- Poorer condenser vacuum due to hot climatic conditions
- Higher unburnt carbon losses in boiler due to low grade high ash Indian coal
- Efficiency is reported on HHV basis of coal (same as the practice followed in USA) as against LHV used elsewhere.

Typical variation due to above = 3.0 to 4.0 % points (Approx.)

Heat Rate Improvement over the Years



Technologies For Clean Energy Production

Adoption of new technologies

- NTPC has been a pioneer in introducing new technologies in the country.
- Currently, super critical technology, advanced class GTs are some of the technologies under induction
- NTPC has worked on development of Integrated Coal Gasification Combined Cycle (IGCC) technology suitable to Indian coal through its collaborative effort with USAID . Further developments are continuing.
- Our Energy Technologies Centre is working in both fundamental and applied fields and has a well-defined mandate to develop various technologies which will enhance plant reliability, efficiency etc. Setting up of this centre by NTPC meets a long-term need of such a centre in Indian power sector.
- MGR, DDCMIS, HVDC transmission, Sliding Pressure Operation of boilers, Combined Cycle power generation, 765 KV transmission are some of the technologies introduced by NTPC fot the first time in India.

Technologies… for cleaner environment

- High Concentration Ash Slurry Disposal System
- Pneumatic Conveying System for Fly Ash
- Pipe Conveyors for Cross Country Coal Conveying
- Vapor Absorption Refrigeration System for all Air Conditioning Requirements of Station
- Ash Water Recirculation System

Steam Generator - Online systems

Online Systems

Online Life Assessment	Online coal Flow Measurement	Acoustic Steam Leak Detection System	Flame Viewing System	Acoustic Pyrometers
On-line system for monitoring/ assessmen of remaining life of critical components of steam generators	On-line fuel measurement facility for accurate measure-ment of coal mass flow rate & air fuel ratio in each PF pipe from each coal pulverizer.	PC based Acoustic steam leak Detection system	Flame viewing system with Flame Cameras for Operators assistance	Temperature measurement at Exit plane & Economiser outlet
All critical areas/ pressure parts such such as thick welded headers, critical Boiler tubes, nozzle connections etc. covered in the on-line life Monitoring System	• sensors/ working on microwave technology • Adjustable orifice in in each PF pipe for online adjustment of coal flow			

Steam Generators - Softwares

SOFTWARES

PADO

- PC based On-line Plant Performance Analysis, Diagnosis & Optimization system for the station
- Provides proper guidance to the plant operator

- Performance analysis &monitoring of systems, process & components
- Emission Analysis and monitoring
- System and performance diagnosis & optimization
- Boiler performance optimization
- Boiler stress condition analysers
- Interactive water and gas chemistry management system.
- Regenerative cycle performance optimization system, Trip analysis
- Calculation for Heat rate, eff, merit order rating, COG, Aux Power

BMW

- Boiler Maintenance Workstation software (EPRI or equivalent) for systematic compilation of Boiler Tube Failures/Pressure Parts history for analysis purpose

- Record the outage details of the plant
- Record the events in pressure parts viz BTF, Inspections and modification
- Record the repair history for the above events
- Carry out the analysis of BTF, remaining life assessment and wear patterns.
- Web enabled with provision of centralized database management.

3D MODELLING

- Review software for 3D model of complete plant layout

Software functions include

- interference check,
- walk-through animation,
- simulation,
- visual effect,
- photo realism

ELECTROSTATIC PRECIPITATOR

NTPC has installed high efficiency Electrostatic Precipitators (ESP) in all its coal fired units.

- Typical Indian coal has 3300 kcal/kg GCV with 45 % ash content
- Four/Six pass ESPs with 10/9 fields each for 500/660 MW unit
- NTPC's ESPs are amongst the world's largest. The largest in NTPC will be at Barhl project with collection area of 364,000 m^2 and foot print size of 66 metres x 112 metres

Highlights

- Electrode spacing of 400 mm
- TR Set Rating of 95 KVA
- ESP efficiency of the order of 99.97%
- Limits Outlet Dust Burden at outlet to 20 mg/Nm3 with design coal

ELECTROSTATIC PRECIPITATOR

Performance of older ESPs are also being improved by using some of the following technologies:

SN	ESP Performance Enhancement Technology	Method in Brief	Result / Data	Potential / Limitation
1	Ammonia conditioning of Flue Gas	Spraying ammonia into flue gas at ESP inlet.	Encouraging results with reduction in emissions to less than 100 mg/Nm3.	The method has High potential for adoption in ESPs. No associated problems.
2	FGC system with SO_3	Spraying SO_3 in to flue gas at ESP inlet.	Encouraging results with reduction in emissions to less than 100 mg/Nm3.	The method has High potential for adoption in ESPs. No associated problems.
3	Retrofit of ESPs	By adding additional fields/increasing		Limitation of space

Flue Gas Desulphurization (FGD)

- **Provision of space is being kept in all existing plants for installation of FGD in future**

- **NTPC is putting up Flue Gas Desulphurization (FGD) plant for its Bongaigaon TPP (3 x 250 MW) which is proposed to use high sulphur (as high as 2%) coal.**

Highlights

- **Adoption of wet lime stone based Gypsum recovery Process**
- **SO2 removal efficiency> 90%**
- **FGD with Dry Stack involving Gas to Gas Heat Exchangers**
- **Utilisation of Gypsum envisaged**

IGCC Developments

NTPC has undertaken following two feasibility studies for 100 MW IGCC plant based on Indian coal (Raw as well as washed):

- **feasibility of 100 MW IGCC plant based on indigenous fluidised bed gasifier technology**
- **feasibility of 100 MW IGCC plant based on international technology.**

IGCC World Experience- all on low ash coal

- Industry is directed towards entrained bed
- Fluidized and Fixed Bed- most suited for Indian coal
- Limited experience on fluidized bed and fixed bed gasifiers world wide

Indian Coal Characteristics

- **High Ash**
- **Low GCV**
- **Fairly Reactive**
- **High Ash Fusion Temperature**

Gasifier Efficiency lower due to high ash Indian Coal and air blown operation

Adoption of IGCC: Techno-economic barriers

- NTPC has carried out two feasibility studies on IGCC: one in collaboration with USAID and the other with an indigenous manufacturer
- Impediments to adoption of IGCC
  - Low carbon conversion
  - Low cold gas efficiency
  - Plant efficiency lower than PC Plant
  - Requirement of a big cleaning system for gases carrying large amount of highly abrasive particulate matter
  - Inadequate experience with higher gasifier pressure
  - 80 to 100% increase in capital cost w.r.t. to conventional plant
  - Relative inexperience with typical coal w.r.t. erosion and availability

Computational Fluid Dynamics (CFD)

- CFD simulation of Boiler and ESP were introduced as part of the Technical Specification, with involvement of NTPC engineers in CFD modeling work.
  - 500 MW ESP flow simulation is being carried out using Star CD Software for validation with model test and improvement in flow distribution.
  - Boiler and ESP simulations shall be carried out by the respective vendors for 500/660 MW projects.

- The following **in house** studies have been conducted to solve station related problems, using Star-CD software.
  - Validation of Flow Modification in convective pass of 62.5 MW to reduce Boiler Bank tube erosion.
  - 500 MW Boiler CAVT Validation using CFD.
  - Flue Gas Duct (APH to ID Fan) Pressure Drop Reduction in 210 MW Unit

Electrical ... Targeting Reliability and Efficiency

Electrical Systems: Thrust Areas

- State of art Electrical System Controls
- Equipments for High reliability and Efficiency
- Operational and Protection Philosophy
- Continual Improvements

State Of Art Electrical System Controls

- Soft Logic in Plant DCS Systems for all Electrical Breakers.
- Substation Automation System introduced for all green field projects.
- Communication Protocol IEC 61850 being used for communication between various IEDs and OWS.
- Switchyard LAN extended to Main Plant Control Room to facilitate un-manned switchyards. Data is soft linked to the plant DCS system.

EQUIPMENTS…EHV

Adoption of Controlled switching of transformer and reactors.

- Up-gradation of transmission voltage from 400kV AC to 765kV AC.
- To improve reliability of EHV transformers NTPC has introduced certain specification enhancements. Enhancements have been carried out in each of the important area of transformer viz.,
  - Dielectric
  - Magnetic circuit
  - Mechanical strength
  - Thermal

EQUIPMENTS… Transformers

- BIL levels have been increased, (Typ. Values for 400kV System): 1300kVp to 1425kVp and Switching Impulse Voltage increased from :1050kVp to 1180kVp
- Temperature rise levels have been reduced for oil from 50 deg C to 35 Deg C and winding from 55 Deg C- to 40 Deg C.
- Type of oil has been changed from Paraffinic to Napthenic type which has a better oxidation stability and thus better life.
- Online DGA. FRA recordings for speedy analysis, identification and rectification of problem.
- For 765kV Class of Transformer, On line Gas Monitoring system & Provision of Dry-keep has been adopted.

EQUIPMENTS… Continued

- On-line PD testing for monitoring the condition of the Generator stator winding insulation.
- State of art MV and LV switchgears with communicable numerical relays
- Reliable DC system with Ni-Cd /Plante type Batteries for relatively maintenance free operations.
- Energy Efficient LT Motors and Lighting appliances.
- VFD drives
- VPI insulation For MV Motors
- Wireless I/O modules in Ash Handling and Coal handling areas for controls.

Protection and Operational Philosophy

- Disturbance Recorders for Generators, have been introduced.
- Numerical Relays have been introduced for all EHV system
- Integrated frequency based islanding scheme for Staggered tripping of grid lines has been introduced.

Controls & Instrumentation

..... State of Art

Transition in C&I

SINGRAULI (1982)

SIPAT II (2006)

LATEST TECHNOLOGICAL ADOPTION IN C&I

- Introduction of plant wide CCTV network for security and surveillance
- Graphical interface units (GIU) used in remote plant
- Ultrasonic and radar based instruments are used for level measurements
- Ambient air monitoring system is being introduced
- Graphical interface unit introduced for remote local control panel
- Focus is on getting more diagnostics information from field devices;
- Hart based field bus based technology is under various stages of adoption
- Wire-less LAN, transmitters and I/Os are being introduced for geographically distributed area

INVESTING IN FUTURE

- INITIATED COLLOBORATION WITH ACADEMIC INSTITUTES AND RESEARCH INSTITUTION IN FOLLOWING AREAS
  - INTELLIGENT SOOT BLOWING SYSTEM
  - BOILER FEED PUMPS RTD FAILURE ANALYSIS AND SUBSTITUTE THERE-OF
  - ACOUSTICS/AUDIO SIGNAL BASED CONDITION MONITORING OF EQUIPMENTS
- State of the art integrated simulator with remote training terminals for 660 MW supercritical technology and hydro power plant are soon to be implemented
- CCTV based infrared cameras in selected areas for night vision


Environment Management

Environment Management… by design

- NTPC has a well defined Environment management Policy
- NTPC has actively gone for adoption of best international practices on environment, occupational health and safety areas and has pursed EMS system ISO 14001 and OHSAS 18001. All NTPC Stations have ISO 14001 & OHSAS 18001 certifications by International certifying agencies.
- Pollution controls systems like ESP, Flue gas Stacks, Low Nox burners, Neutralization pits, Coal settling pits and DE & DS systems for better air quality are in place in all power plants.
- Cooling Towers, Ash dyke and Ash disposal systems and Ash water recycling are installed for better water management and saving fresh water.

Environment Management …in operations

- Monitoring of Environmental parameters

  All Pollutants discharged from the power plant such as Stack emission, ash pond effluents , main plant effluents , domestic effluents are monitored at stipulated frequencies. Ambient air, Surface water and ground water quality are also regularly monitored.

- Upgradation and Retrofitting of Pollution control systems

  In order to keep pace with changing environmental norms retrofitting and up gradation of pollution monitoring and control facilities in existing plants is also taken up

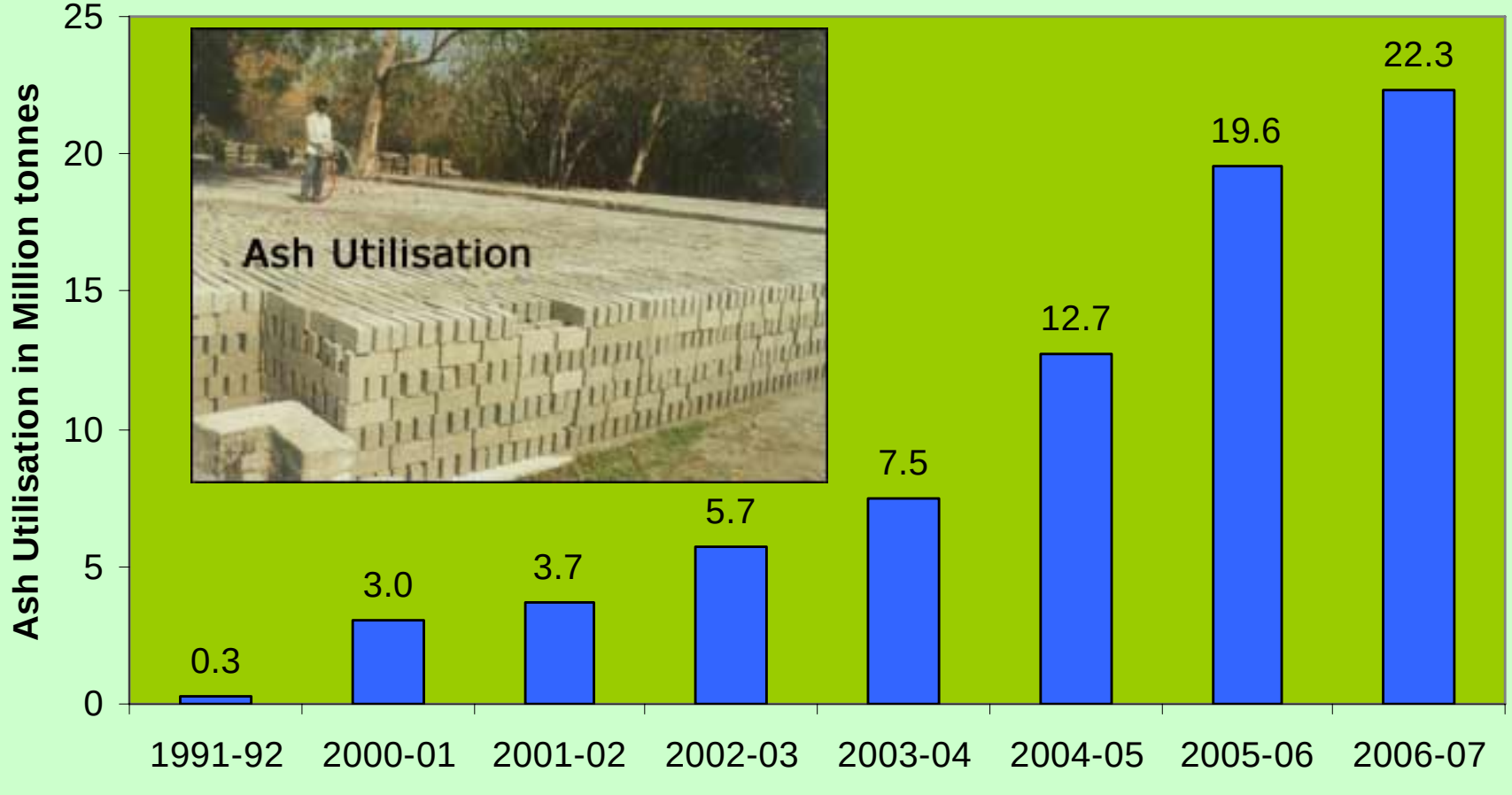
- On Line data Management is in place for environmental performance of the power stations.

Reducing and Recycling Waste

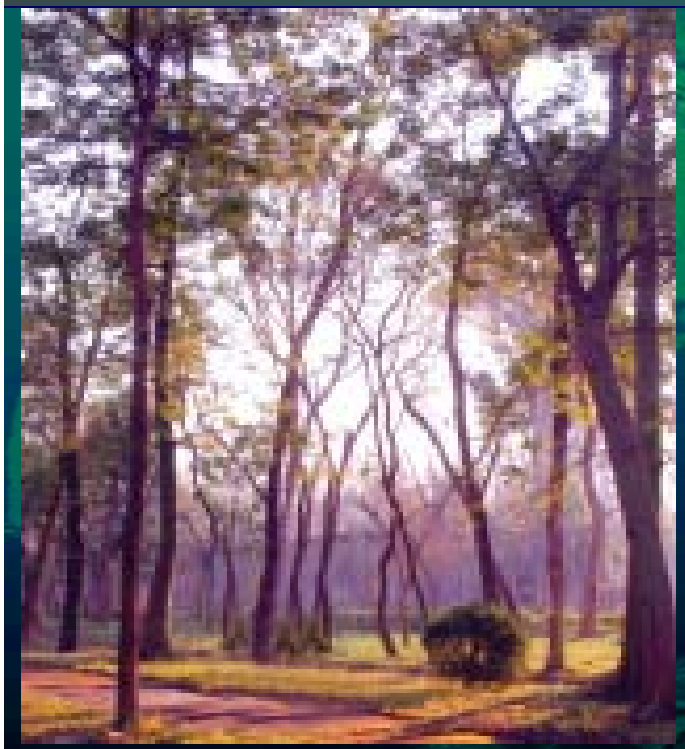
- Hazardous waste management as per GOI rules of 1989 is done and recyclable wastes and non recyclable waste are suitably treated. The non recyclable wastes are sent to the State Pollution Control Board for common treatment, storage and disposal facility.
- Land Use/ Bio-Diversity... As a Policy NTPC lays special emphasis on land use . Development of green belts, energy plantations, , reclamation of Ash ponds and EIA studies for ecological monitoring in the project areas and its surroundings.
- Reclamation Of Abandoned Ash Ponds... Extensive plantations has been undertaken on dry ash mound at NTPC DADRI

Fly Ash Utilization Record

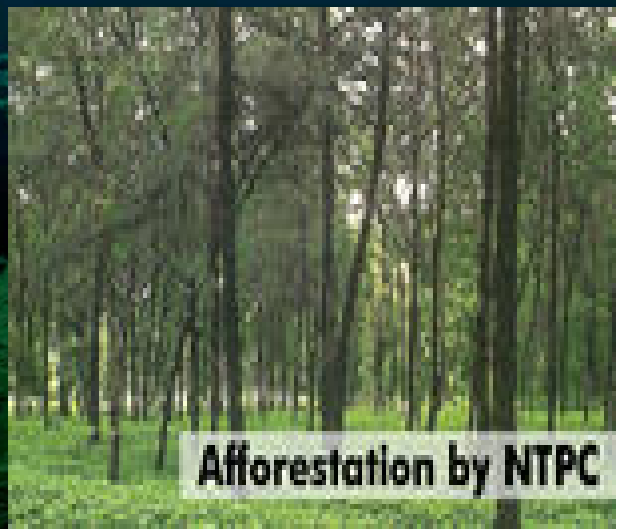
Highest ever utilisation of Fly Ash a testimony to ecology preservation



Afforestation …



- Forest Banks concept
- NTPC has created a Green wealth of 18.2 Million Trees by Summer 2007
- Plantation of 1.25 Million trees around Ramagundam Project has resulted in Summer Peak temperature reduction by 3 deg C
- Ash Mound Reclamation and Dry ash disposal system



Way Forward ....
Renewable energy &
Distributed Generation

Renewable energy & Distributed Generation

- Renewable energy (RE) is being perceived as an alternative source of energy for "Energy Security" and subsequently "Energy Independence" by 2020..
- Broad base generation mix by evaluating conventional and non-conventional sources of energy to ensure long run competitiveness and mitigate fuel risks.
- NTPC has formulated its' business plan of capacity addition of about 1,000 MW thru renewable resources by 2017

Portfolio of renewable power

SNo	Renewable Energy Sources	Capacity
1.	Wind energy farms	650 MW
2.	Small Hydro Project	300 MW
3.	Solar PV Power Project	5 MWe
4.	Solar Thermal	10 MW
5.	Biomass Power Project	15 MW
6.	Geothermal Power Project	30 MW

Foray into Renewable Energy

- ✓ 100 MW wind farm
- ✓ 8 MW hydro based plant at Singrauli
- ✓ 4 MW hydro based plant at Rihand
- ✓ 5 MW biomass based power plant
- ✓ 1 MW bio-diesel based power plant (in cluster of villages)
- ✓ Identification of potential site (s) for geothermal based power plant

Renewable Power & Distributed Generation

The traditional model of centralized grid extension could not achieve the goal as :

- **Grid extension not viable for remote areas due to low demand & high distribution network cost.**
- **Kerosene Oil still preferred source as villagers get light when they need it.**
- **Rural Feeders remain neglected by utilities due to low revenue realization. Importance given to urban feeders for commercial reasons.**

By harnessing Renewable Energy Sources, Distributed Generation is a viable option to provide electricity to the millions of people in remote areas.

NTPC's Commissioned DG Projects

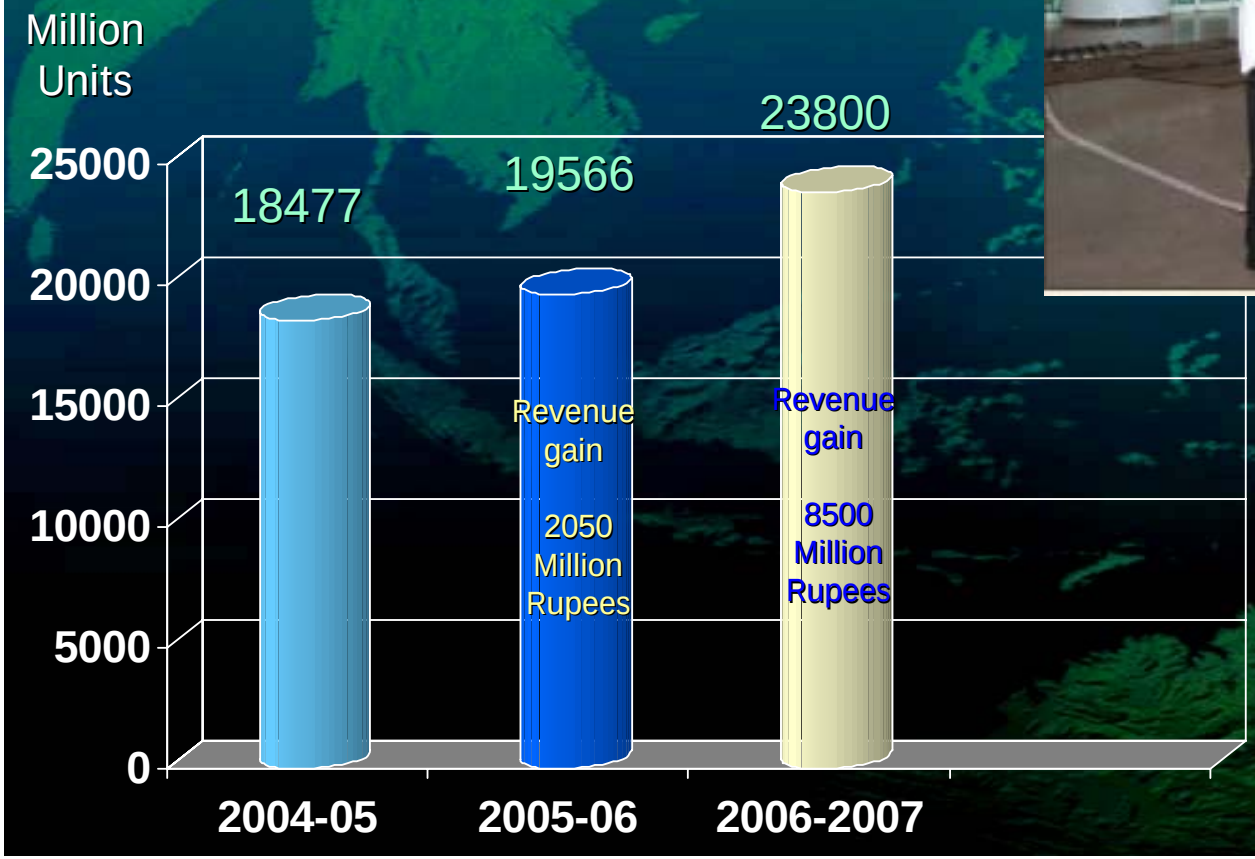
Jemara (Korba), 10kW, 100HH, Biomass (Woody)	13.02.05
Jaraha-Chetwa (Rihand), 10.5 kW, 200 HH, Solar PV	28.03.05
Bhaogarh (Anta), 10kW, 89 HH, Biomass (Mustard crop)	23.03.06
Bagdara (Korba), 20 kW, 110 HH, Biomass (Woody)	12.07.06
Uchlenga (Korba), 20 kW, 134HH, Biomass (Woody)	19.10.06
Khirti (Korba), 20 kW, 105 HH, Biomass (Woody)	05.11.06
Piprahar (Rihand) , 25 kW, 160 HH, Biomass (Woody)	28.04.07
Mahuli (Rihand), 30 kW, 183 HH, Biomass (Woody)	29.06.07

Partnership in Excellence

Partners in Excellence (PIE)

- NTPC has brought about Performance turnaround in 13 low performing stations of India having 5050 MW
- ***NTPC assisted stations to generate additional 2833 million units which is equivalent to 430 MW capacity at 75 % average PLF***
- Three Tier Approach was envisioned. The first steps were
  - ✓ Gap analysis
  - ✓ Formation of Counter Teams
  - ✓ Up front improvement in generation through optimization of operation parameters, vacuum improvement, Mill maintenance, combustion optimization and focus on water chemistry.
- Introduction of O &M Systems and Procedures & Initiate practice of opportunity Maintenance
- Planned Major overhauls

PIE Program … an Impact analysis



The Turnaround

	ADDITIONAL GENERATION	MW ADDED TO THE GRID	PLF	REVENUE
Wave I (0ct05-Mar06)	1025 MU	235 MW	73.7 %	205 Cr INR
Wave II (Apr06-Dec06)	2572 MU	390 MW	73.5%	514 Cr INR
Wave III (under progress)	2833 MU	861 MW (till Nov 07)	75%	797 Cr INR

The Turn around was based on NTPC practices and procedures with customization of needs for each Individual Station and utility.

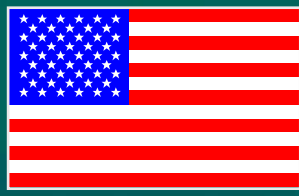
CenPEEP - Symbol of NTPC's Commitment for

Sustainable Development

&

Successful International Cooperation

CenPEEP - Centre for Power Efficiency & Environmental Protection



CenPEEP - Symbol of NTPC's Commitment for

Sustainable Development

&

Successful International Cooperation

Centre for Power Efficiency & Environmental Protection

- Institution set-up to implement Indo-US project of *'Greenhouse Gas Pollution Prevention Project (GEP)'*
- Window for technology transfer
- An example of NTPC's concern for environmental protection and commitment to sustainable power development in India

CenPEEP Partnership

CenPEEP

- NTPC
- Guj. Gen Co
- Maha Gen CO
- AP Gen CO
- PSEB
- UPRVUN
- WBPDCL
- Jharkhand
- IPGCL

- USDOE
- NETL
- EPRI
- TVA
- GAI
- Southern Research
- Structural Int.
- Domain Experts

Guided by
Advisory Board & Executive Committee

Members from NTPC, USAID and Govt of India,
State & Private Power Utilities, industry, research institutes, etc.

Utility Challenges for Efficiency Improvement

- Access to state-of-art technologies
- Lack of expertise and agency for evaluation and gap analysis
- Lack of system documentation
- Training expertise
- Lack of resources for implementation & sustainability

CenPEEP Approach

State-of-the art technology & practices for GHG reduction from existing coal fired power stations and new power generation capacities

Sustainability through implementation of Systems & Procedures

Grass Root Interventions

Candidate Interventions

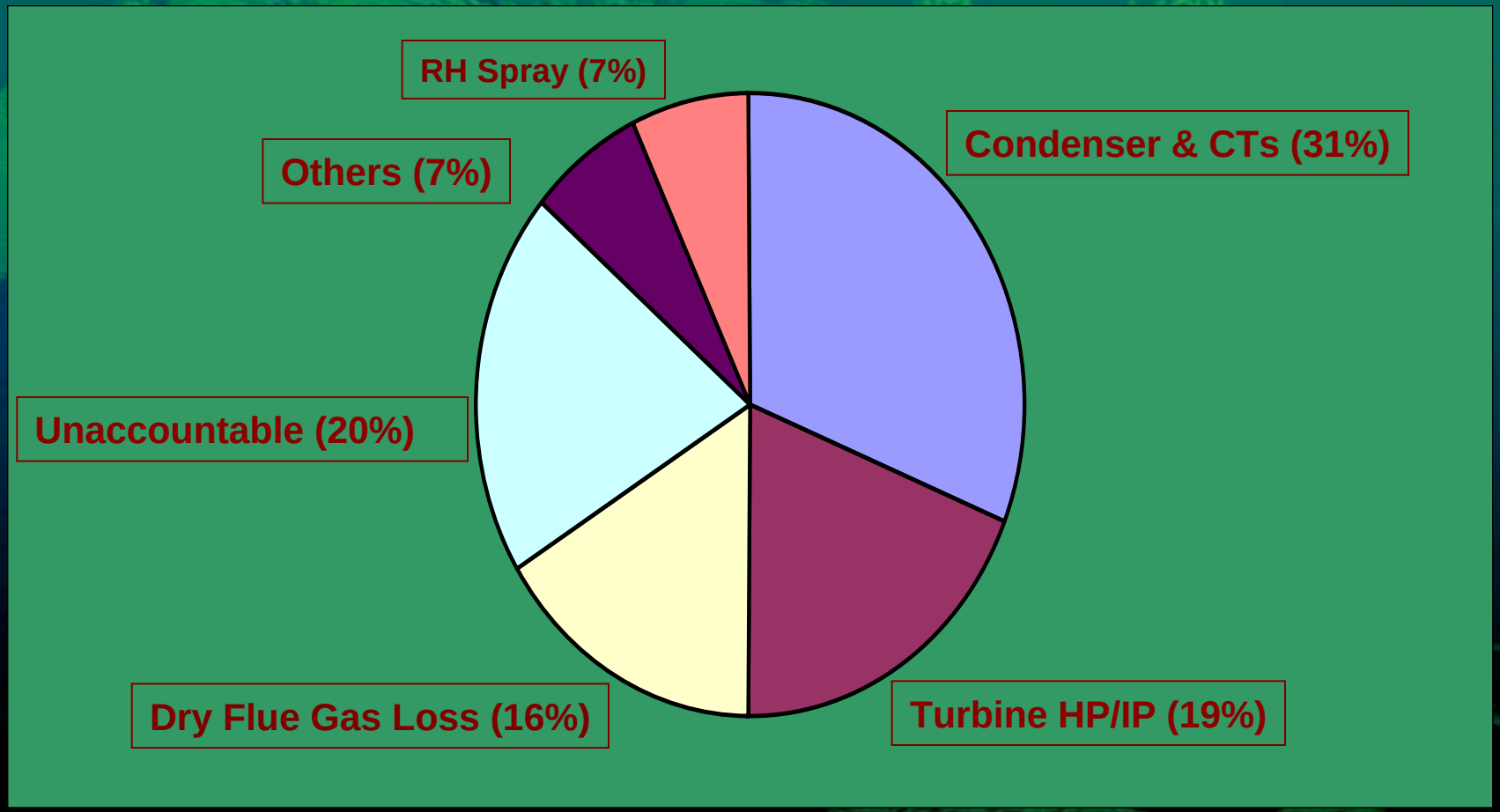
- Boiler Performance Optimization
- Air heater tests and gap analysis
- Burner to burner PF balance tests
- Steam Turbine measurements
- Condenser Water Pressure Cleaners
- Condenser Helium leak detector
- CW flow measurement - dye dilution
- Cooling Tower tests
- Reliability Centered Maintenance
- New overhaul practices

Benefits

- Significant GHG reduction
- Fuel Savings in power sector

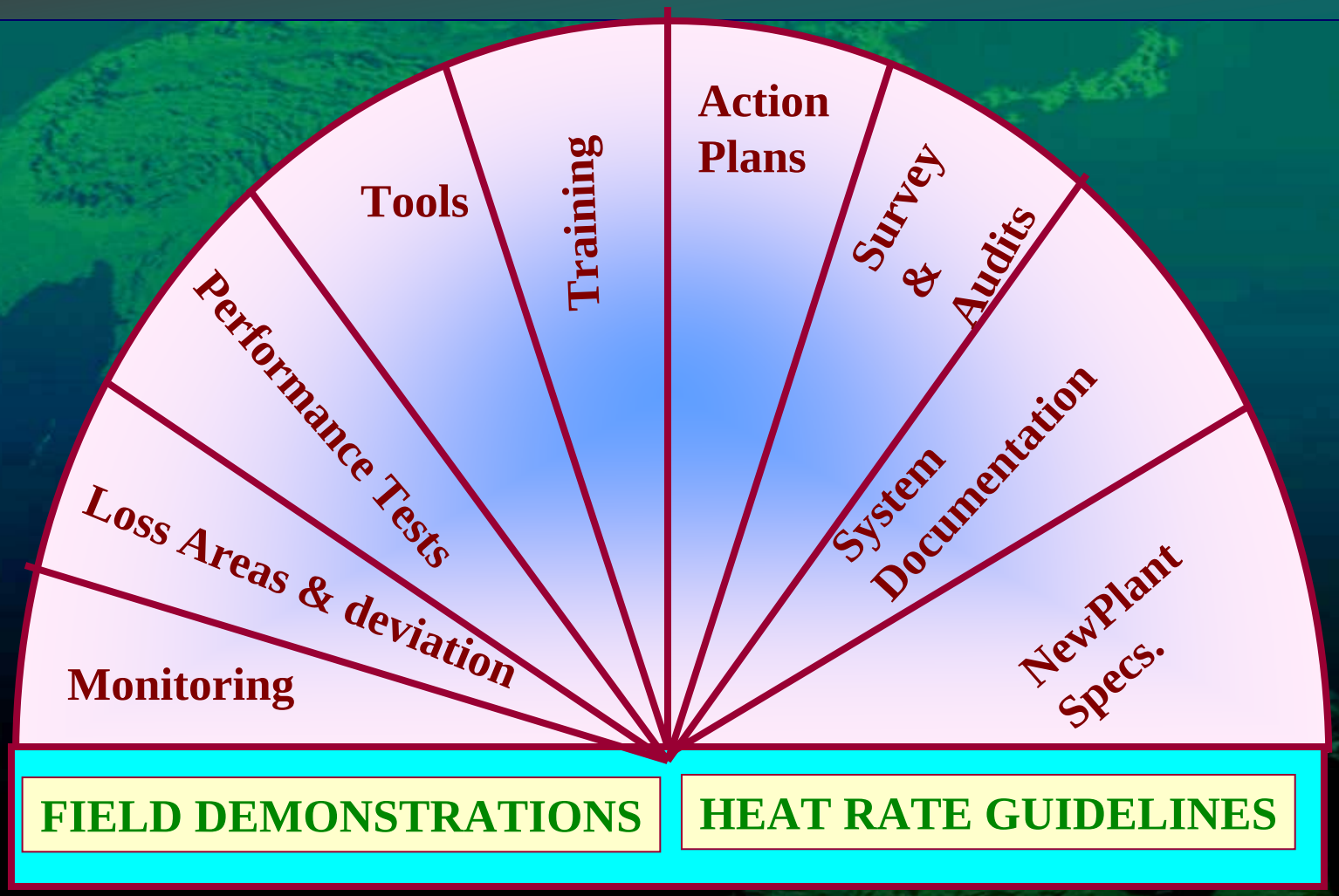
CenPEEP is a resource center for Plant performance optimization, Diagnostics & Solutions

Performance Gaps (Typical Heat Rate Losses)



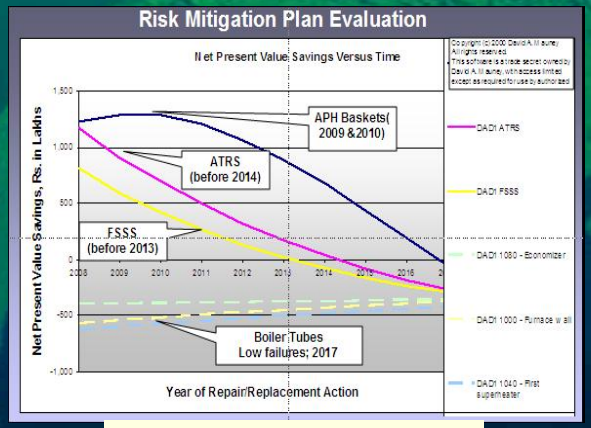
Assessment of the performance gaps is the first step to improvement

Heat Rate Improvement Guidelines for Indian Power Plants

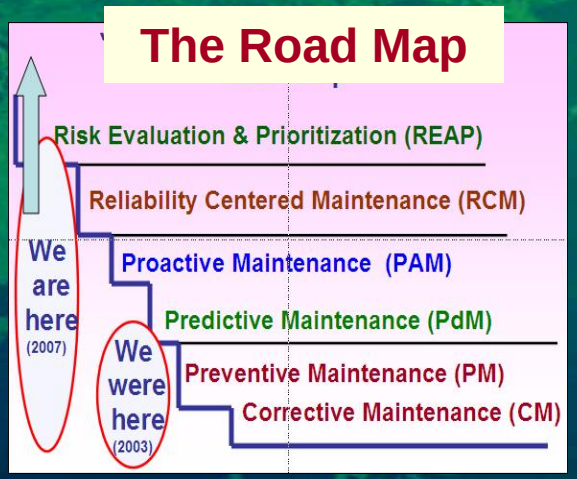


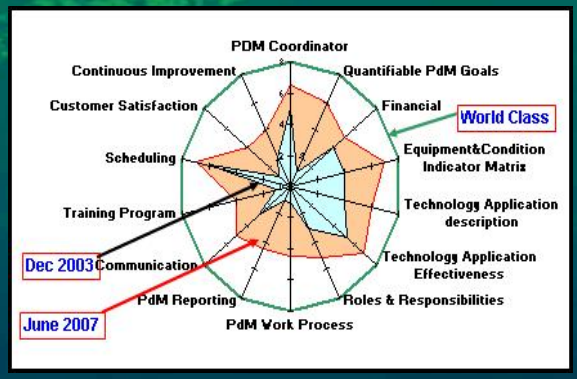
Consolidation of Learning from CenPEEP Program

High Availability & Reliability - key to sustained efficiency improvements



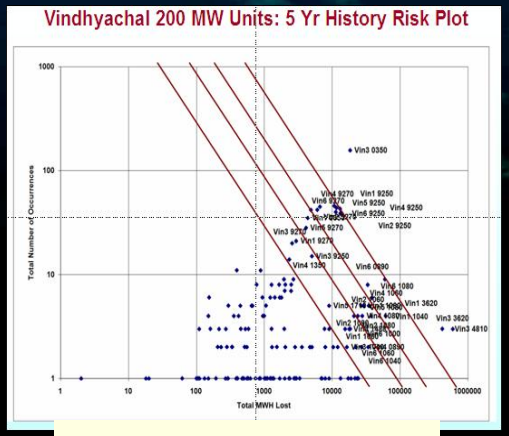
Risk Mitigation





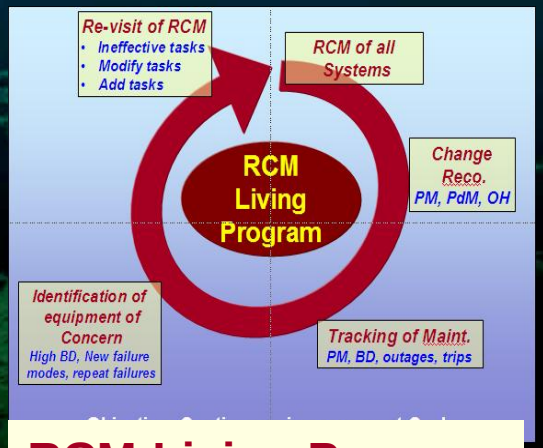
PdM Improvements

Availability Improvement Initiatives



Risk Screening

Activity	CO_2 Mitigation	
	Type	Effectiveness
Reducing Planned Outage	Avoided	Med /High
Reducing Forced Outage	Avoided	High



RCM-Living Program

Widespread Dissemination

- **125 Workshops on Boiler & Turbine Analysis & Performance Improvement; Diagnostics and Knowledge Based Maintenance**
- **14000 Training man days - Participants from NTPC, DVC, GSCEL, UPRUVNL, TNEB, APGENCO, PSEB, RRUVNL, MSEB, IPGCL etc.**
- **319 Demonstrations - Hands-on training**
- **Guidelines on Thrust areas**
- **Papers at various conferences**
- **Customized training programs organized at SEBs as per their needs**

Optimisers

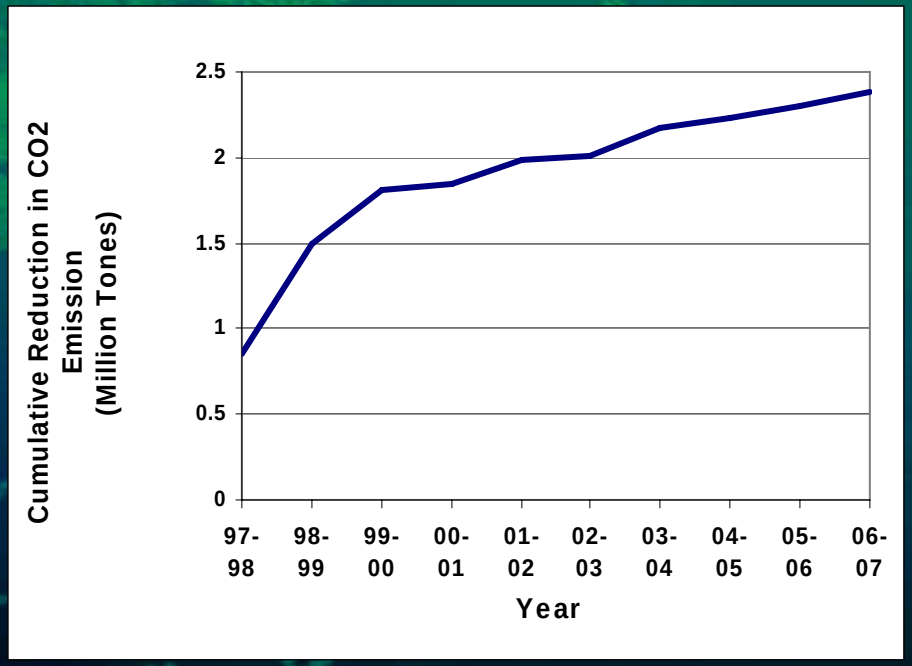
available on NTPC website

Quarterly newsletter

Supported by 48 US team visits of over 1050 man days

CenPEEP program lead to CO2 abatement

- CO_2 savings of over 2.4 Million Tons in NTPC
- Institutionalization through EMC



Successful replication in SEBs:

- **Maharashtra SEB: reported savings of about 4 million tons of coal & of 5 million tons of CO_2 in two years using CenPEEP tools**
- **UPRVUNL reported reduction in coal consumption by 2.5% in one year by implementing learning from CenPEEP awareness Programs**

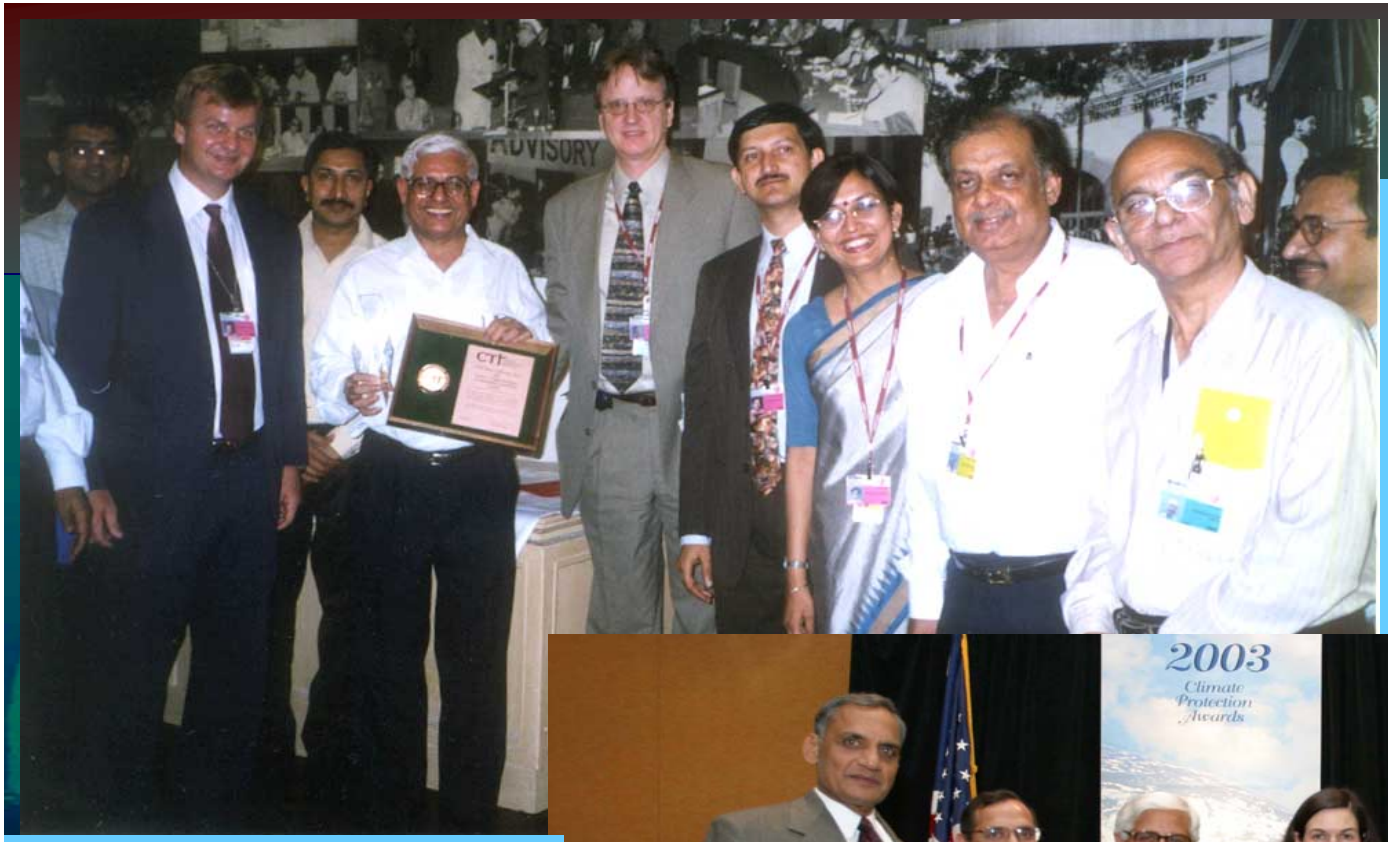
Cooperation Impact - evaluating performance for a longer term

Evaluation Dimensions

- Competency Upgradation
- Institution Scalability
- Roll out potential
- Sectoral Benefits
- Public benefits
- Knowledge creation, management & optimisation
- IT Enablement

The interventions have been quite effective to elevate the contemporary sectoral conditions but there is surely scope to make the impact deeper and wider

CenPEEP has made a good beginning, improvements to be sustained for a large fleet



CTI's World Climate Technology Award 2002

USEPA CLIMATE PROTECTION AWARD 2003

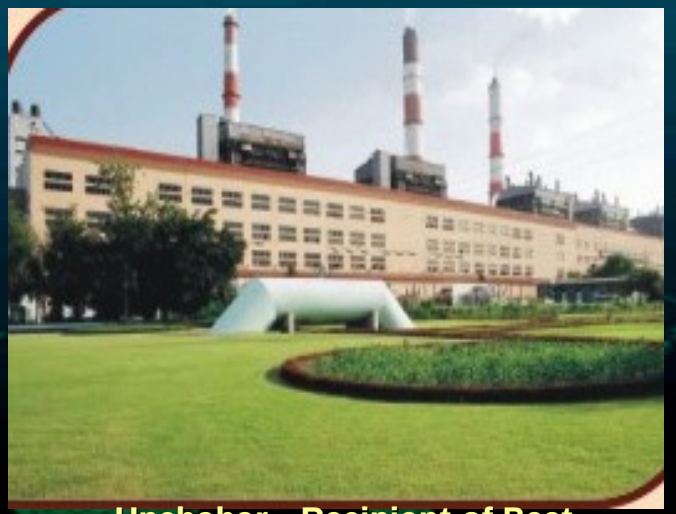
Awards & Recognitions

Operation and Maintenance

- Gearing up for future challenges

O & M : Gearing up for future challenges

- Regional Operation Performance reviews
- Performance Evaluation Matrix
- Institutional Building and Knowledge Teams
- Over Hauling Preparedness Index
- Web based Enterprise wide MIS
- OPC compliance for ERP
- Automated SMS
- Condition Monitoring of all major equipments
- RLA
- Modular replacements

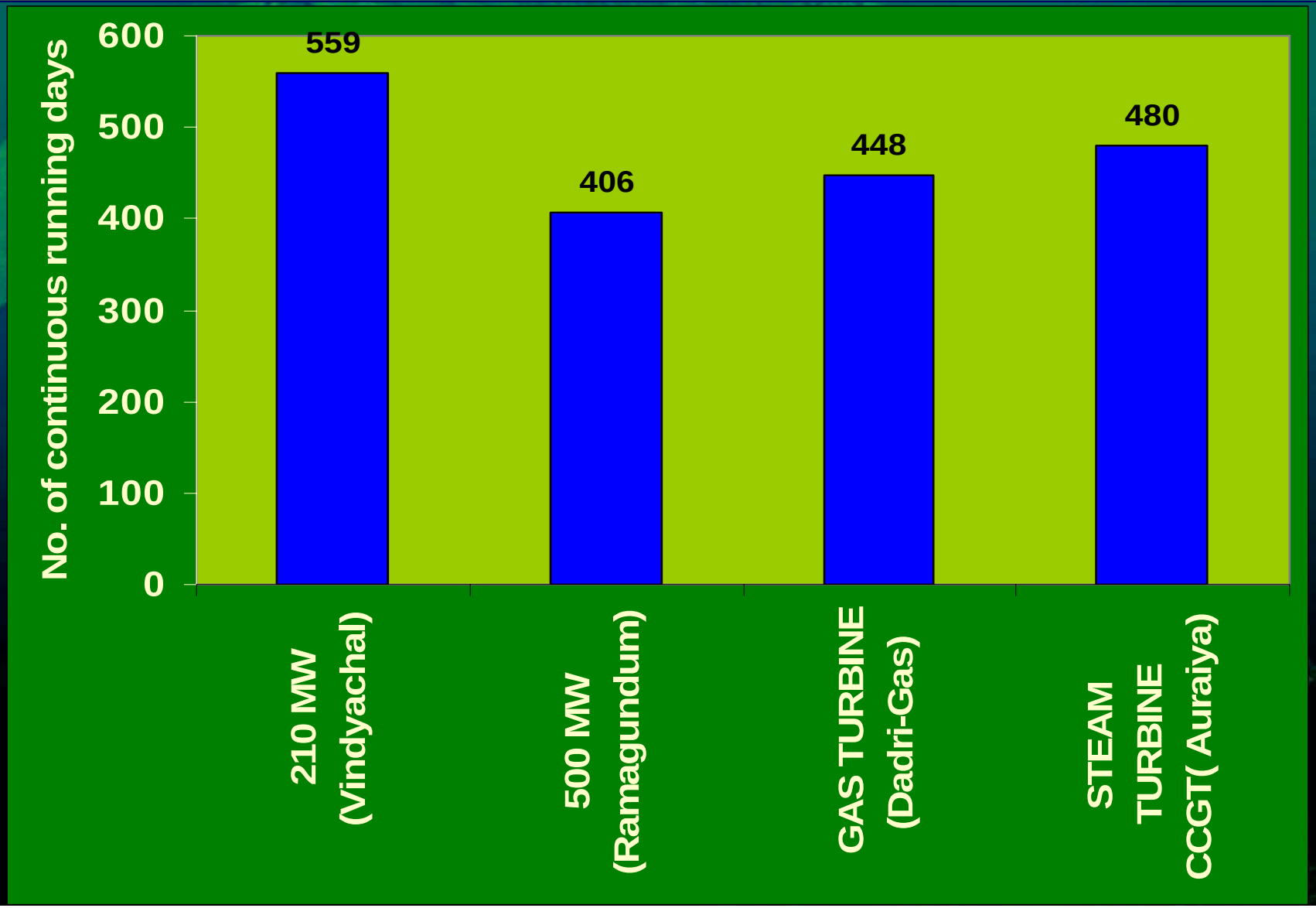


Unchahar - Recipient of Best Asian Power Plant Award 2006

All Time High Plant Load Factor

- All time high PLF of 89.43% achieved by NTPC Coal Stations in 2006-07
- 9 Coal Stations amongst the top 20 stations of the country in terms of PLF in 2006-07
- 8 out of 13 Coal Stations have achieved 90% PLF in 2004-05
- NTPC's first power plant (Singrauli) maintaining average PLF of 91% even after 25 years of operation

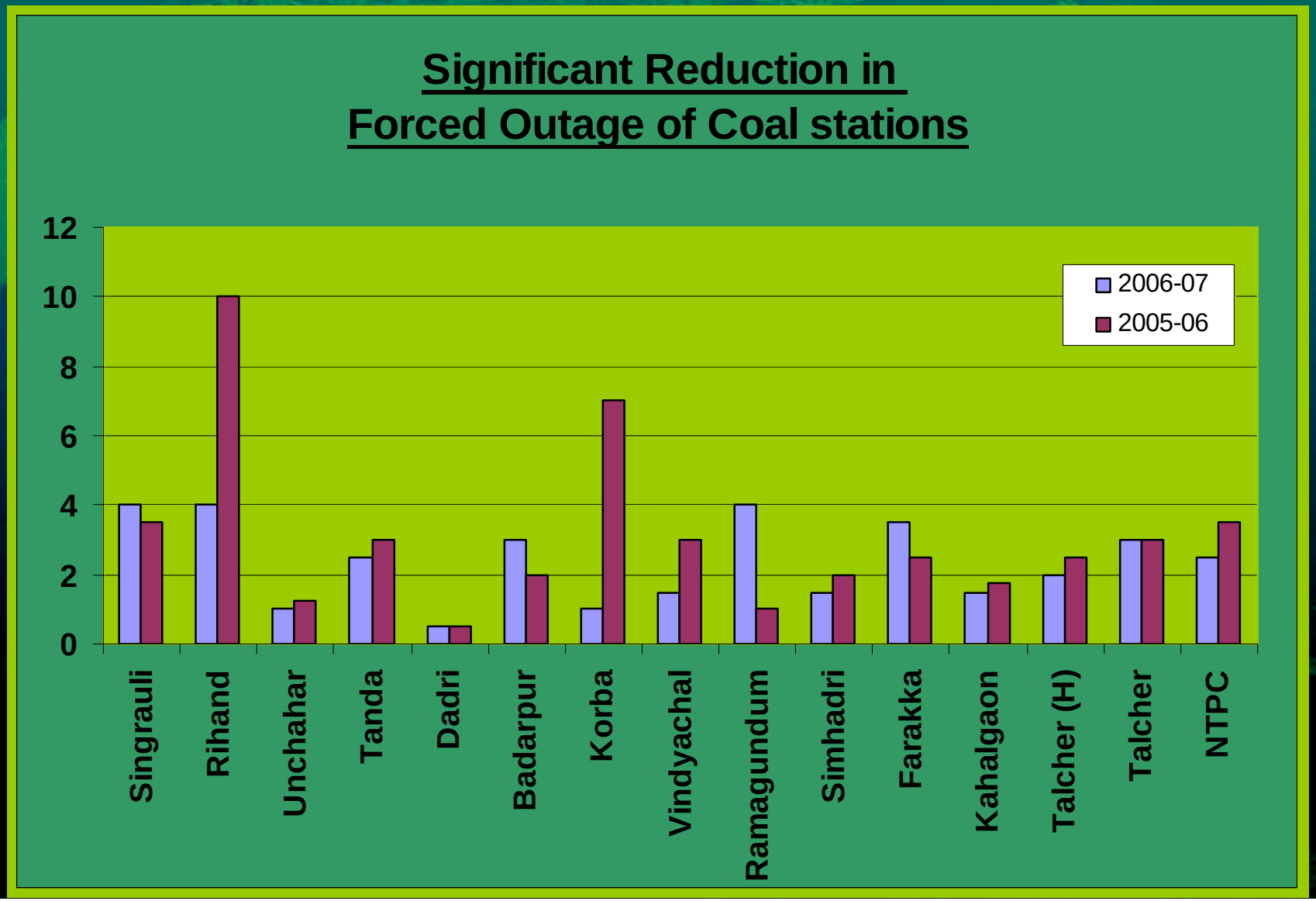
Established O&M Practices



Maintenance Optimisation

- Project REAP
  - Phased implementation of shift in maintenance strategy from enhanced predictive maintenance to risk based maintenance
- Latest diagnostic tools in use
  - NFT for Generator stator, RSO for Generator rotor, online DGA, FRA, DCRM for circuit breakers, online LPT blade crack detection, increased use of Thermography, etc.

Maintenance Marvel



O&M Practices

- Well defined guidelines for O&M of units
- Safe and reliable operation in rated parameters
- Strict adherence to water chemistry and environmental norms
- Established procedures for startup and shutdown
- Compliance to statutory requirements

O&M Practices

- Standardised recommissioning procedures
- Daily safety checks
  - Oil & hydrogen quality checks, system protections checks, trial of emergency equipment, fire protection systems check, etc.
- PTW system
  - Isolation, lockout, maintenance and normalisation activities are strictly through online system

GAS TURBINE

Performance Monitoring and Improvement

Present Practice:

- Capacity gap analysis carried out by various important parameters like Ambient Temperature, Ambient Pressure, Compressor discharge Temperature and Pressure, Turbine exhaust Temperature, WHRB inlet and Exit Temperature etc.
- Compressor efficiency, Heat Rate and Power Output is calculated periodically for Combined Cycle based on the available feed back of parameters On line as well as Off-line. The calculated values are compared with Design and the Operation of machine is further Optimised.
- Remedial actions for repair and replacement of component or system responsible for degradation is planned and executed in shut down.
- Off line Vibration analysis is carried out for Turbines and Auxiliaries and Suggested remedial action is taken up during shut down.

Energy Conservation Efforts

Practices adopted for reduction of plant Auxiliary Power Consumption

- Monitoring of energy /specific energy consumption of individual drives through Online Energy Management System.
- Encouraging use of variable frequency drives in different areas like Induced Draft Fans, Condensate Pumps etc.
- Structured energy audits of different areas of the power plant to identify energy loosing areas with timely implementation of recommendations to plug these.
- Polymer coating of pump internals for sustained efficiency improvement of Circulating Water Pumps, Low Pressure / High Pressure Ash water pumps etc.
- Adoption of vapour absorption system (using environment friendly Lithium Bromide) for central air conditioning of control rooms etc in place of vapour compressor system (using ozone depleting freon gases).
- Switching over from existing GLS lighting to energy efficient CFLs/FTLs.

Systems

- Well defined Technical Compliance system
  - Defines directives and guidelines for unit operation and maintenance
- Daily plant data forms 3 tier information system
  - Analysed separately at station, region and corporate
- Monthly review of station performance in ORT
- Regional review by top management every quarter
- Additionally, regions and corporate undertake Technical Audits, Peer Reviews, and Surveilance ORTs on a planned schedule
- Stations conform to ISO 9001

Institution Building

- Knowledge teams
  - Aims to strengthen technical resources
  - Members selected on expertise, knowledge and experience
  - Functional in areas of Turbine, Boiler, Electrical, C&I and Offsite
  - Involvement in overhauls, troubleshooting, fact finding, problem analysis
- Specialized training programs
  - Identified members are trained in specific areas

Overhaul Quality

- Minimise forced outage from overhaul to overhaul
- Prepare comprehensive scope of work
  - Inputs from past experiences, knowledge teams, RLA analysis, failure history analysis, performance assessments, etc.
  - Finalised 2 yrs before overhaul
  - Reviewed regularly
- Operation Preparedness Index - OPI
  - Assess preparedness of spares & service contracts for overhaul
  - OPI calculation, monitoring and corrective action is through monthly ORT and quarterly review in ROPR
- Emphasis on modular replacements to increase performance and reliability

Conclusion

Summing Up

In its endeavor for greener future, NTPC is committed to

- green house gas abatement
- ambient air quality improvement and
- effluents and waste management

For meeting these objectives, actions are taken at following stages

- Planning and design stage
- Plant operation stage
- Assisting other utilities in achieving improved plant availability and efficiency through PIE and CenPEEP

Summing Up

Design and Planning Steps

- Subcritical 500 MW units will have enhanced reheat steam temperature of 565^{O}C instead of 537^{O}C
- All future units of 660 MW and larger capacity shall be supercrtical units with parameters of 247 ata/ 565^{O}C/ 593^{O}C
- Ultrasupercritical units to be adopted after gaining operational experience from the supercritical fleet under execution now
- Broaden energy mix to include
  - Renewables (1000 MW from wind and solar by 2017)
  - Hydro, predominantly Run of River type (1920 MW under construction, 4791 MW under planning)
- Dry collection of fly ash and incentivization of entrepreneurs to make use of ash
- Ash water recirculation system to recycle decanted water from ash dykes
- Adoption of high concentration ash slurry disposal system
- Promote biomass/solar/wind based Distributed Generation in remote villages for rural electrification

Summing Up

Maximizing plant efficiency during operation

- Robust system of plant performance review on monthly basis by experts from stations/regional/corporate offices
- Plant efficiency being evaluated and compared with the design values on a monthly basis by dedicated experts from Efficiency Deptt.
- All latest units (2004 onwards) equipped with PADO – a s/w based diagnostic, analysis and optimization tool – for operator guidance
- Improvement in maintenance practices with long and rich experience has led to sustained improved performance of coal pulverizers and air preheaters, the two main culprits for bolier efficiency
- Planned inspection and intervention by CenPEEP to plug efficiency gaps
- Regular energy audits to review plant parasitic power consumption

Summing Up

Assistance/guidance to other utilities through PIE & CenPEEP interventions

- Turnaround knowhow to State Electricity Boards through dissemination of expertise & operation & maintenance best practices.
- Efficiency enhancement and availability improvements will lead to significant amount of reduction in CO_2 emissions
- The interventions have been demonstrated to be effective in raising the contemporary sectoral conditions

http://www.ntpcindia.com

Thank you