UPRATING ,RENOVATION & MODERNIZATION OF AGEING THERMAL POWER PLANTS

PRESENTATION BY

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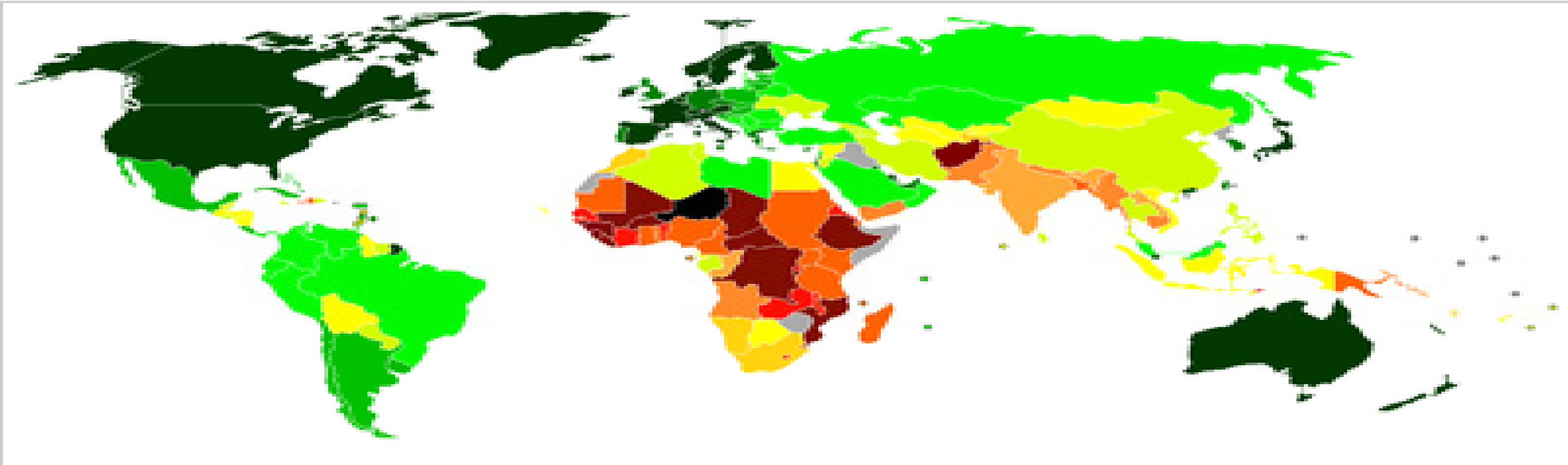
NTPC-INDIA

Outlook on Power Sector In INDIA

The crux of sustainable growth of the economy

Human Development Index

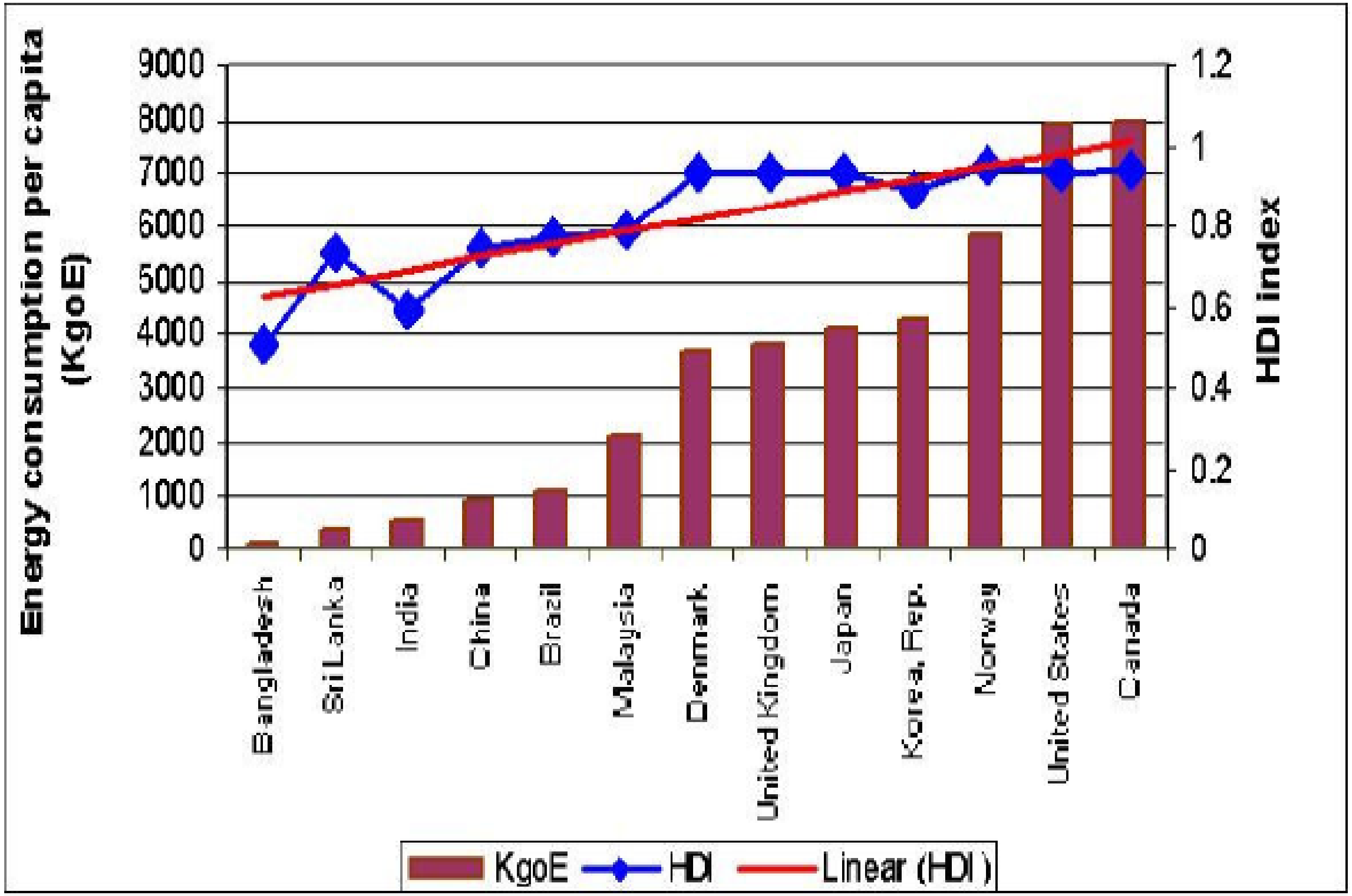


World map indicating the Human Development Index (based on 2007 data, published on October 5, 2009)[citation needed]

0.950 and Over	0.700–0.749	0.450–0.499
0.900–0.949	0.650–0.699	0.400–0.449
0.850–0.899	0.600–0.649	0.350–0.399
0.800–0.849	0.550–0.599	under 0.350
0.750–0.799	0.500–0.549	not available

3 ELEMENTS OF HDI-LIFE EXPETENCY,ADULT LITERACY,STANDARD OF LIVING

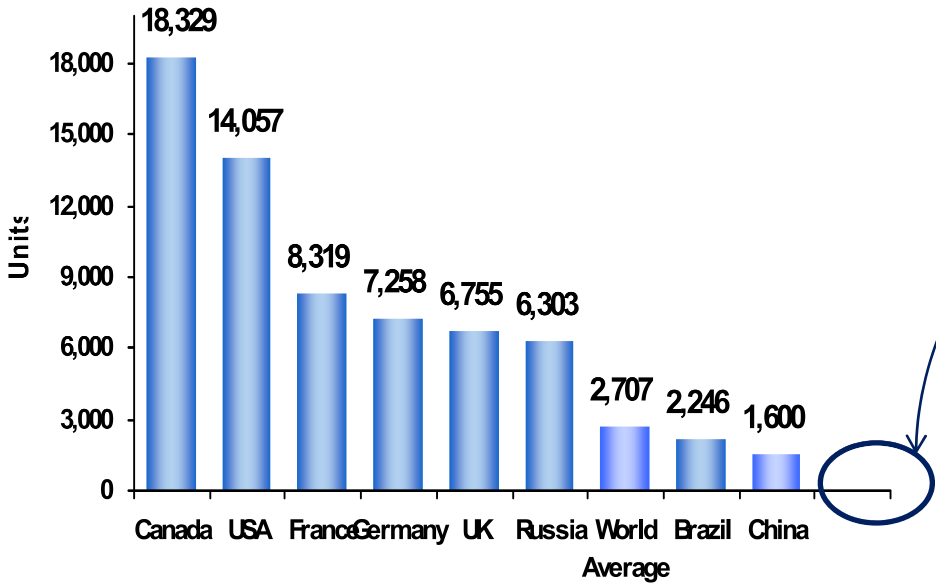
ENERGY CONSUMPTION



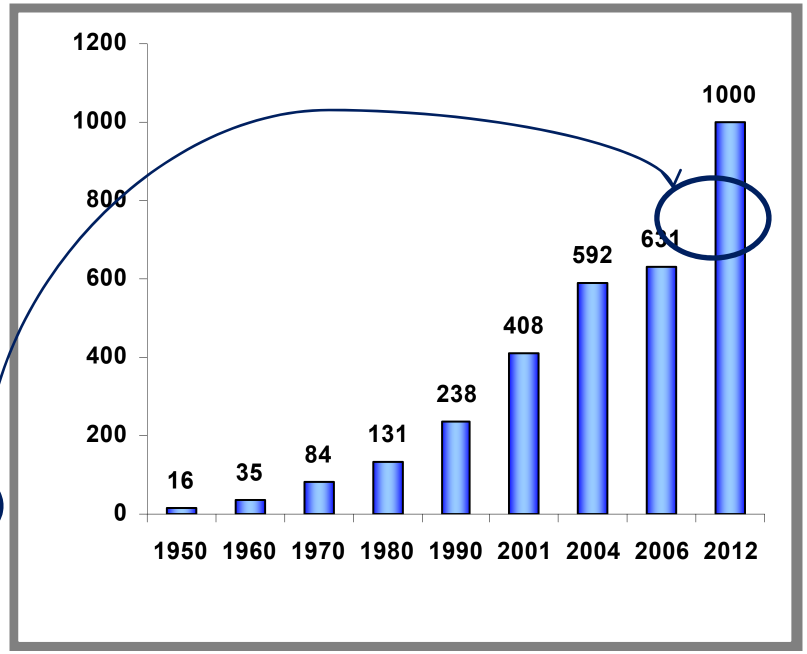
ENERGY CONSUMPTION IS A PRIME DRIVER OF HUMAN INDEX

India - Per Capita Power Availability

India – Very low Per Capita Consumption



India – Per Capita Growth / Projection



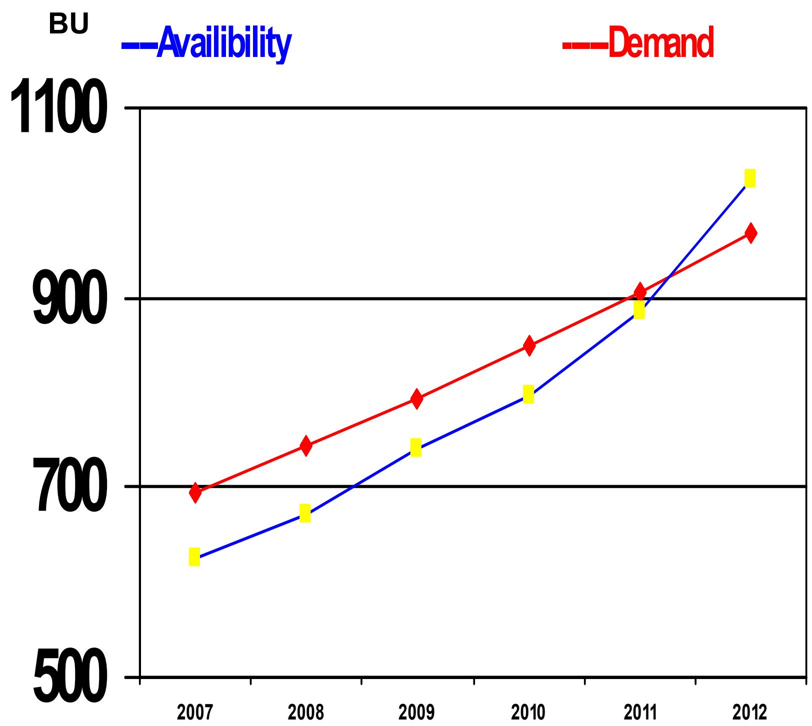
India Per Capita Power Availability is far less than its peer BRIC economies and about 1/4th of World Average

Power Projections for India

Growth Projections (at 9% GDP)

Particulars	2006	2012	2017	2022	2027
Generation Capacity (GW)	124	216	333	512	790
Per capita consumption (kWh)	631	1000	1300	1900	2800

Demand & Supply of Electricity



Installed capacity in India

(As on 30-11-09)

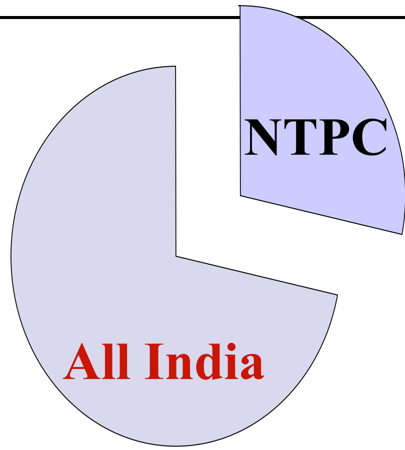
SL. NO.	REGION	THERMAL				Nuclear	HYDRO	R.E.S.@	TOTAL
		COAL	GAS	DSL	TOTAL		(Renewable)	(MNRE)	
1	Northern	20062.50	3563.26	12.99	23638.75	1180.00	13310.75	2240.31	40369.81
2	Western	27015.50	8143.81	17.48	35176.79	1840.00	7447.50	4563.18	49027.47
3	Southern	17822.50	4159.78	939.32	22921.60	1100.00	11107.03	7880.76	43009.39
4	Eastern	16645.38	190.00	17.20	16852.58	0.00	3904.12	334.91	21091.61
5	N. Eastern	60.00	766.00	142.74	968.74	0.00	1116.00	200.08	2284.82
6	Islands	0.00	0.00	70.02	70.02	0.00	0.00	6.11	76.13
7	All India	81605.88	16822.85	1199.75	99628.48	4120.00	36885.40	15225.35	155859.23

Captive Genrating capacity connected to the Grid (MW) = 19509

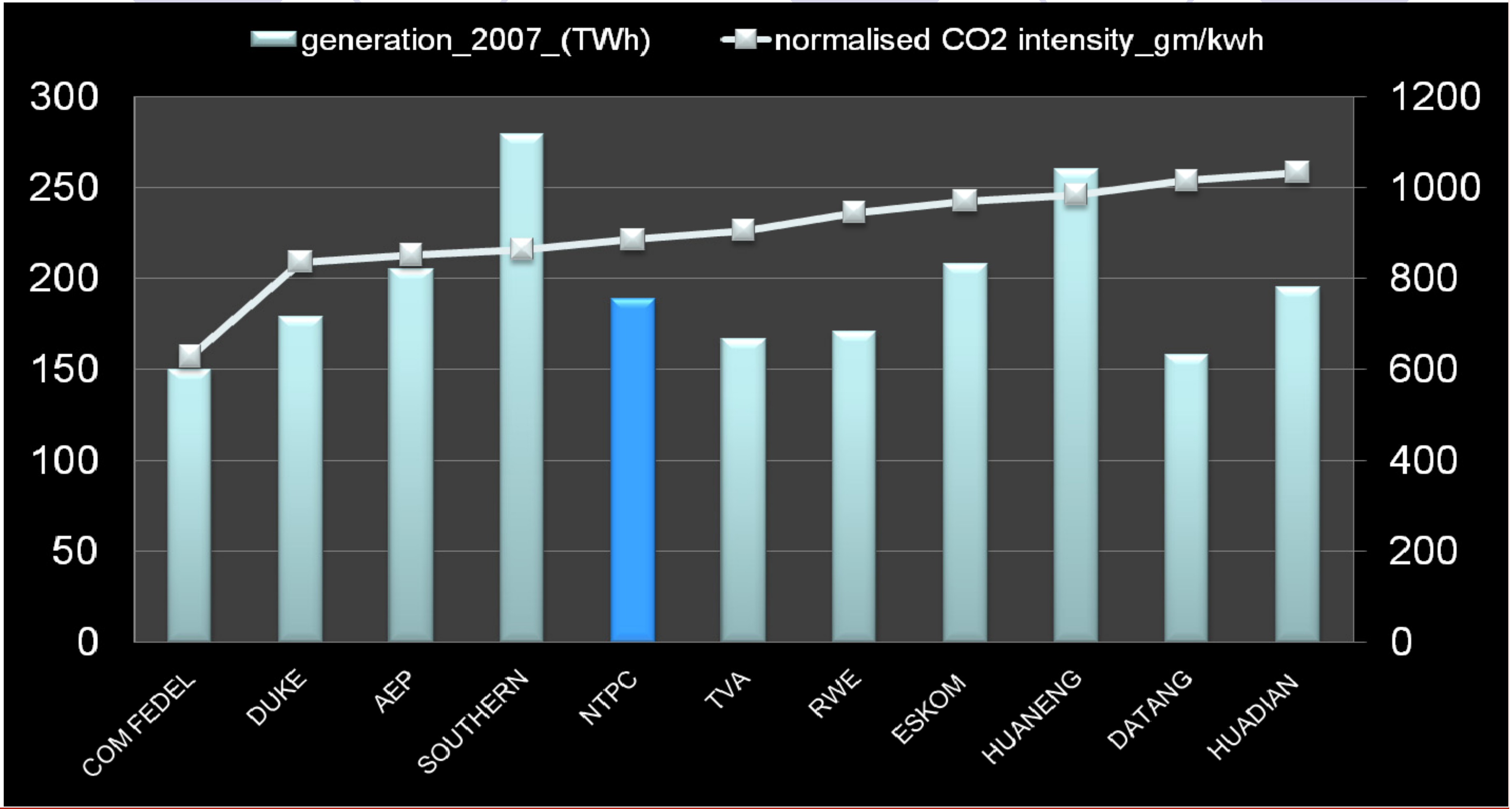
RES -Renewable Energy Sources includes Small Hydro Project(SHP), Biomass Gas(BG), Biomass Power(BP), Urban & Industrial waste Power(U&I), and Wind Energy.

PROFILE AND ROLE OF NTPC

NTPC- Powering India’s Growth

NTPC contributes more than one-fourth of India’s total power generation with less than one-fifth capacity			
Total Capacity **As on 01.01.2010**		**Generation** **2008-09**	
NTPC- 31, 134 MW	 	**NTPC- 206.94* BU** **29 % of all India** **704 BU**	
* Excluding JVs			

NTPC – AMONGST THE CLEANEST FOSSIL FUEL POWER GENERATORS



Assumptions:
1)The largest generating companies with Annual generation above 150 BU
2)The companies having minimum fossil fuel mix of 50%

SOURCE: CARMA.ORG: NTPC ANALYSIS*

RENOVATION & MODERNISATION

Why R&M

✓The requirement of power is felt as an important input for economic growth, More so in a power deficit scenario like India.

✓In power deficit scenario , each unit of power Generated or saved has equal importance, in mitigating the situation.

✓In such a scenario .Renovation and modernization of older units is one of the least cost effective means of generating additional power at lower rates and with a shorter gestation period.

R&M and Re-powering

- *India has large fleet of old power plants which are in operation below design capacity with poor efficiency.*
- *Operating parameters like pressure and temperature of these old power plants are low and many of them are without reheat cycle.*
- *Available Fuel is at variance with that considered during power plant design.*
- *Some of the equipments/system have undergone degradation.*
- *Technological developments including uprated /upgraded design can be leveraged for increase in power generation at relatively lower cost to consumer.*
- *Technological advancement can be harnessed to improve the cycle efficiency of power plant and help in mitigating green house gas emission.*

R&M Back Ground

- Planned R&M started in 1984
- Programme & Achievements in various Five Year Plans

S.No.	5-Year Plan	No.of Units	Capacity (MW)	Additional Generation Achieved MU/Annum	Equivalent MW
1	7th Plan	163	13570	10000	2000
2	8th Plan (R&M) (LEP)	198 (194) (4)	20869 (20569) (300)	5085	763
3	9th Plan (R&M) (LEP)	152 (127) (25)	18991 (17306) (1685)	14500	2200
4	10th Plan (R&M) (LEP)	25 (14) (11)	3445 (2460) (985)	2000	300

Details of 11th Plan Programme- R&M -129 units-26283 MW

Market scenario for R&M

- ✓ Large number of smaller capacity units like 50 / 62.5/100MW units are being operated with poor efficiency.
- ✓ Large fleet of 200/210MW units (53 Nos.) with LMZ turbines are more than 20 years old, can be retrofitted with modified turbines to sustain/ enhance output and efficiency.
- ✓ Due to continuous operation, many of the units the equipment and system have undergone ageing process resulting in
  - Reduced output.
  - Obsolescence.
- ✓ 200/210 MW (37 Nos.) & few 500 MW units which are more than 15 years old can also be considered depending on resources and plant condition.

EVOLUTION OF UNIT SIZE AND COAL POWER PLANTS IN INDIA

Period	1950s	1960s	1970s	1977	1983	Under Constrn.
Unit Size	30 MW to 50 MW	60 MW to 100 MW	110 MW to 120 MW	200 MW to 250 MW	500 MW	660 MW
Turb Inlet Pressure / Temp	60 ata 480^{0}C	70 to 90 ata 490 to 535^{0}C	130 ata 535^{0}C	130 ata 537^{0}C	170 ata 537^{0}C	247 ata 537^{0}C
Reheat Temp.	No Reheat	No Reheat	535^{0}C	537^{0}C	537^{0}C	565^{0}C
Turbine Cycle Heat rate (kCal/kW-hr)	2470	2370	2060 to 2190	1965	1945	1900
Gross efficiency (%)	29	30.5	33 to 35	37.2	37.6	38.5

PREVAILING UNIT SIZES IN INDIA

Unit Size	MS. Pr	MS/RH Temp	Gross Efficiency (HHV)
	kg/cm^2	°C	(%)
30-50	60	482	~31
60-100	90	535	32-33
110/120/140	130	535/535	35-36
210	150	535/535	37.8
250	150	535/535	38.4
500	170	538/538	38.6

210/250 & 500 MW UNITS CONSTITUTE OVER 80 % OF TOTAL CAPACITY.

POTENTIAL CANDIDATE PLANTS FOR R&M

Age	Total No.of Units	No.of Units as Potential Candidates. >15 &< 25years	> 25 years
200/210 MW LMZ Units	**66 * 2units<15 years**	**28**	**36**
200/210 MW KWU Units	**98* 41 units <15 years**	**48**	**09**
500 MW Units	**40* 22 units<15 years**	**17**	**1**

Large portion of existing capacity (15000 MW) can be considered for R&M on priority basis at an Investment Requirement of the order of US 6 billion $.

Objectives of Energy Efficient R&M

- R&M of existing old units Primarily aimed at generation sustenance and to over come problems due to :
  - Generic Defects
  - Design Deficiencies/Modifications
  - Non-availability of spares due to obsolescence of equipments/Components.
  - Inadequacies arising due to poor quality of coal.
  - Stringent environmental regulations.
  - Safety Requirements.
  - Change of focus from "Generation Maximization to Performance optimization" with Efficiency enhancement and uprating.

Critical factors affecting Energy efficiency

- **Steam Generators**
  - Combustible losses in furnace and ash.
  - Excess Air Control.
  - Final Flue Gas temperature at Air Preheater outlet.
  - Feed water temperature at Economizer inlet.
  - Boiler Water chemistry.
  - Leakages of steam/Water leading to additional water make up.
  - Condition of Boiler insulation.
- **Steam Turbines**
  - Condenser Back Pressure.
  - Turbine inlet steam parameters like pressure , temperature and flow.
  - Turbine Reheat attemperation.
  - Removal of Bauman stage in LMZ sets.

IMPACT OF INDIAN CLIMATE AND COAL ON EFFICIENCY

<table>
<tr><th>Parameter</th><th>Impact on Gross Efficiency (%)</th><th>Impact on Aux. Cons (%)</th></tr>
<tr><td>CW Temperature (33 Vs 15) ^{o}C</td><td rowspan="2">2-3%</td><td rowspan="2">1.5%</td></tr>
<tr><td>Indian Coal</td></tr>
</table>

Benefits of Efficiency focused Renovation for Typical 210 MW

Description	Pre R&M	After R&M (Targeted)	% Change
Turbine Heat Rate Kcal/Kwh	2240	2000	12
Boiler Eff -%	82-84	85	-
Unit Heat Rate kcal/kwh	2700	2300 to 2500	7 to14
C02 Emission (g co2 / Kwh)	992	846 to 918	7 to 14(Reduction)

R&M Experience in NTPC

The R&M solutions recommended & implemented in NTPC stations are plant specific. Many of the solutions are unique and tried for the first time. Some of these are listed below

- Addition of 7^{th} coal Pulveriser in Tanda Boiler to have Redundancy operation of pulveriser due to deterioration in coal quality from design value.The FSSS also has been modified to accommodate the 7^{th} mill operation.
- Redesigning of 60 MW boilers and Milling system upgradation at Talcher TPS to meet deviation in characteristics of fired coal in comparison to design coal.
- Vindhyachal -DDCMIS of Russian Units .
- Retrofitting of existing LMZ design HPT,IPT & LPT steam turbine of 210MW units which are of old impulse design with modified design turbine module.
- Renovation of Gas turbine at Anta which are of ABB 13D2 model.
- Up gradation of existing C&I system for Gas turbine & steam turbine at Anta.

Scope for R&M in NTPC (Age Profile of NTPC Stations)

Age Of Units	No. of Units			
	Thermal	Gas Turbines	Comb. Cycle Steam Turbines	Total
0 to 25,000	7	0	0	7
25,000 to 50,000	7	0	0	7
50,000 to 75,000	6	4	2	12
75,000 to 1,00,000	9	7	0	16
100,000 to 1,50,000	19	11	7	37
1,50,000 to 2,00,000	22	0	1	23
More than 2,00,000	8	0	0	8
Total	78	22	10	110

68 units of NTPC has crossed 100,000 hours of operation

R&M activities under implementation in NTPC

Station	Module	Capacity
Singrauli	5x200+2x500	2000
Korba	3x200+3x500	2100
Ramagundam	3x200+3x500	2100
Vindhyachal Stg I	6x210	1260
Farakka Stg I	3x200	600
Rihand Stg I	2x500	1000
Talcher TPS	4x60+2x110	460
Tanda TPS	4x110	440
Anta Gas Power Station	3x88.71+1x153.2	419.33

TOTAL = 8379.33 MW

Issues & Challenges in Implementation of R&M schemes

❖Whether to go to OEM or open tender.
❖Whether to adopt Turnkey concept or package wise.
❖Whether to go in for all the units or staggered after reviewing the performance of earlier units.
❖Sequential supplies of equipment, timely execution, availability of additional items due to surprises are important aspects in execution.

❖Guarantees, penalties, scope growth, cost overrun and delays to watch interest of all concerned.

❖Shortage of energy (difficulty in getting shutdowns).
❖Fast obsolescence of C&I components /system.

Issues & Challenges in Implementation of R&M schemes

•Role of Regulators: The Regulatory mechanism should act as a catalyst and should be seen as an enabler.

•Poor financial health of power utilities.

•Establishing techno-economic viability.

•Efficacy of RLA studies.

•Addressing of Balance of plant generic issues and proper assessment.

•Complexity in complying environmental concerns and the cost involved.

Way Forward

- Renovation of ageing power plants with energy efficient technologies represents an excellent opportunity to increase plant efficiency and availability in a cost effective way besides reducing CO2 emissions significantly and facilitate meeting. national commitment.
- In the past, Power Plant Renovation focused mainly on reliability improvement and life extension. In the future, efficiency-focused Renovation should be pursued. Power Plant Renovation with Energy efficient technology can improve plant efficiency by 2-5 percentage points which is equivalent to 6-15% reduction in the fuel and the CO2 emissions . Its high time that tail of inefficiency is tucked in and concentrate on improving efficiency
- Although site-specific assessments are needed to determine the nature and extent of scope and investment, many studies and actual renovation projects have concluded that energy efficient renovation is the “low-hanging fruit” in terms of mitigating energy requirements and CO2 reductions.
- Older inefficient units to be phased out.


Thank You