

Industry Insight

Indian Power Sector

July 2007

Cygnus

Business Consulting & Research

Knowledge Partner For Profitable Growth

4th & 5th Floors, Astral Heights, Road No. 1, Banjara Hills, Hyderabad-500034, India

Tel: +91-40-23430303-05, Fax: +91-40-23430201, E-mail: info@cygnusindia.com

Website: www.cygnusindia.com

Disclaimer: All information contained in this report has been obtained from sources believed to be accurate by **Cygnus Business Consulting & Research** (Cygnus). While reasonable care has been taken in its preparation, Cygnus makes no representation or warranty, express or implied, as to the accuracy, timeliness or completeness of any such information. The information contained herein may be changed without notice. All information should be considered solely as statements of opinion and Cygnus will not be liable for any loss incurred by users from any use of the publication or contents

SYNOPSIS

Total installed capacity for power in India as on 31.12.06 was 127,753 MW and Government of India plans to add capacity of 100,000 MW by 2012.

India had been traditionally depending on thermal power as a major source of power generation, which constitutes about 65% of current capacity. Balance is contributed by Hydel power (26%), Nuclear (3 %) and Renewable energy (6%).

Over 87% of the current installed capacity in the country is by the government; with the state governments having lion's share of over 52% and the balance by central (federal) government. Due to the initiative of government of India to encourage Public Private Partnerships in power sector, share of private companies' power generation capacity has gone up to steadily to 17,112.62 MW, about 13 % of the installed capacity. With Government of India opening up Ultra Mega Power Projects (UMPP) for private investments, a number of private companies, including overseas companies, have been increasingly showing interest in investing in power projects. State-owned Power Finance Corporation, which is the nodal agency for the UMPP, has set up nine Special Purpose Vehicles (SPVs) to conduct preliminary studies and obtain government approval for the planned projects. Once these SPVs will become operational it will generate a capacity of 36,000 MW power. Renewable energy offers a huge potential as a physical target of 15,000 MW with an outlay of Rs.39,250 million is proposed for grid interactive/ distributed renewable power generation during 2007-12. The total investment required would be about Rs600 billion

This report covers the overall industry scenario, demand & supply, growth drivers, critical success factors for the industry. It also deals with investment opportunities in the sector and an outlook.

The report is useful for industry analysts, banks and financial institutions, investors, consultants, corporates engaged directly or indirectly in the industry and international readers who want to keep abreast of the Indian Power industry.

The report has 169 pages and is organised into 12 chapters (excluding Ex. Summary and Highlights) containing 36 figures, 61 tables and 4 annexures (Statutory & regulatory clearances, bibliography and abbreviations used).

CONTENTS

Executive Summary.....	10
Highlights	11
1. Overview	12
1.1 Introduction	12
1.2 Generation.....	12
1.2.1 Segment Wise Generation.....	13
1.2.2 Sector wise Contribution.....	13
1.3 Transmission.....	14
1.4 Distribution.....	15
1.5 Consumption	15
1.5.1 Consuming sectors.....	15
1.5.2 Sector wise Consumption.....	16
1.5.3 Trend in consumption in different sectors	17
1.5.4 Per Capita consumption	17
2. Segments in Power Generation	19
2.1 Thermal.....	19
2.1.1 Overview of current status	19
2.1.2 Technology	20
2.1.3 Profile of major projects	26
2.1.4 Investment Opportunities	28
2.1.5 Future Outlook	29
2.2 Hydro	30
2.2.1 Overview of current status	30
2.2.2 Profile of major projects	32
2.2.3 Investment Opportunities	37
2.2.4 Future Outlook	37
2.3 Nuclear.....	37
2.3.1 Overview of current status	37
2.3.2 Nuclear Power Reactors & Technologies	38
2.3.3 Profile of major projects	40
2.3.4 Investment Opportunities	45

2.3.5 Future Outlook	45
2.4 Wind	46
2.4.1 Overview of current status	46
2.4.2 Technology	47
2.4.3 Profile of major projects	48
2.4.4 Investment Opportunities	53
2.4.5 Future Outlook	54
2.5 Solar.....	54
2.5.1 Overview of current status	54
2.5.2 Technology	55
2.5.3 Profile of major projects	56
2.5.4 Investment Opportunities	58
2.5.5 Future Outlook	59
2.6 Biomass	59
2.6.1 Overview of Current Status.....	59
2.6.2 Technologies in Biomass Generation	60
2.6.3 Incentives by government for promotion.....	61
2.6.4 Biomass projects.....	64
2.6.5 Investment Opportunities in Biomass Power.....	67
2.6.6 Future Outlook	68
2.7 Emerging Trends in Technology.....	69
2.7.1 Hydrogen	70
2.7.2 Fuel cells.....	70
3. Transmission and Distribution	71
3.1 Overview of Current Status	71
3.1.1 Under construction.....	72
3.1.2 T & D losses	73
3.3 Investment Opportunities	73
3.4 Future Outlook.....	74
4. Demand for Power	75
5. Growth Drivers.....	77
5.1 Growth in Indian Economy	77
5.2 Reforms Undertaken by Government.....	77

5.3 Encouragement in Foreign Direct Investments	77
5.4 Fiscal Incentive Provided by Government.....	77
5.5 Development of Ultra Major Mega Projects	78
5.6 Large Reservoir of Untapped Hydro Electricity	78
6. Major Players in Generation, Transmission and Distribution	79
6.1 Generation - Thermal Power Companies.....	79
6.1.1 National Thermal Power Corporation Limited.....	79
6.2 Nuclear Power Company.....	83
6.2.1 Nuclear Power Corporation of India Limited	83
6.3 Hydro Power Companies.....	87
6.3.1 National Hydroelectric Power Corporation.....	87
6.3.2 North Eastern Electric Power Corporation Limited.....	92
6.3.3 Damodar Valley Corporation	96
6.3.4 Jaiprakash Hydro Power Limited	100
6.4 Wind Power Companies.....	103
6.4.1 BF Utilities Ltd.....	103
6.4.2 Indo Wind Energy Limited	106
6.5 Biomass Power Companies	108
6.5.1 Clarion Power Corporation Limited & Rithwik Energy systems Limited	108
6.5.2 Arashi Hi-tech Bio-Power Pvt Ltd	109
6.5.3 10 kW Biomass Gasifier plant at Chhattisgarh	110
6.6 Power Transmission & Distribution.....	113
6.6.1 Power Grid Corporation of India	113
6.6.2 Reliance Energy Limited.....	117
6.6.3 Tata Power.....	122
6.7 Power Financing.....	128
6.7.1 Power Finance Corporation	128
6.8 Power Equipment Manufacturers	131
6.8.1 Suzlon Energy Limited.....	131
6.8.2 Tata BP Solar Limited	135
6.8.3 Photon Energy Systems.....	137
6.8.4 Anu Solar Power Pvt Limited	138
7. Regulations & Policies	139

7.1 Electricity Act 2003.....	139
7.2 Status of Power Sector Reforms	140
7.2.1 State Reforms Acts	140
7.2.2 State Electricity Regulatory Commissions.....	141
7.3 Foreign Direct Investment Policy	143
7.3.1 Automatic Route	143
7.3.2 Generation and transmission of electricity.....	143
7.4 Income Tax Benefits.....	143
7.4.1 Incentives on Return on Investment (equity).....	143
7.4.2 Other incentives.....	144
7.4.3 Related incentives	144
8. Ultra Mega Power Projects	145
8.1 Introduction	145
8.2 Benefits of UMPPs	145
8.3 Current Status.....	146
8.3.1 Special Purpose Vehicles.....	146
8.3.2 Allocation of Power to UMPPs.....	147
8.4 Issues & Challenges.....	148
8.5 Future Outlook.....	150
9. Issues & Challenges	151
9.1 High Transmission and Distribution Losses.....	151
9.2 Power Theft- Biggest threat to industry.....	152
9.3 Demand supply mismatch	152
9.4 Regulatory hurdles	153
9.5 Global Participants in Power & Distribution Transformer Market.....	153
9.6 Inadequate Generation and Transmission Capacity	153
9.7 Quality of supply and maintenance of grid discipline.....	153
9.8 Subsidized price inflicts losses.....	154
9.9 Price hike in Transformer Raw Materials	154
9.10 Acute Shortage of Fuel Supply	154
9.11 Poor Quality Coal	155
9.12 Untapped Renewable Energy Sources.....	155

10. Critical Success Factors	156
10.1 Generation	156
10.1.1 Sourcing & management of funds are very critical to the project ..	156
10.1.2 Selection of location for Hydro & Wind power projects is important to ensure optimum generation	156
10.1.3 Success lies in controlling project implementation schedule	157
10.1.4 Roping in the private partner is a big deal	157
10.1.5 Smooth supply of Raw material for coal based projects will ensure ceaseless generation	157
10.1.6 The demand supply gap for coal will lead to increased import of coal	158
10.1.7 Meeting environmental requirements is a social responsibility	158
10.1.8 Improving the capacity utilisation of the existing projects will make it more viable	158
10.1.9 Meeting safety norms for nuclear power is an international requirement	158
10.1.10 Encouraging industrial entities to be self reliant on power can give additional mileage to the sector	159
10.2 Transmission & Distribution	159
10.2.1 Reducing Transmission & Distribution (T & D) losses can save huge money	159
10.2.2 Private participation in distribution can improve distribution management	159
10.2.3 Effective utilisation of IT in transmission sector development	160
11. Michael Porter Analysis	161
11.1 Threat of new entrants	161
11.2 Intensity of rivalry among existing competitors	161
11.3 Bargaining power of buyers	161
11.4 Bargaining power of suppliers	162
11.5 Threat of substitutes	162
12. Future Outlook	163
Annexure 1: Power Projects – Statutory & Non-statutory clearances	164
Annexure 2: Bibliography	166
Annexure 3: List of Abbreviations	167
Annexure 4: Power Map of India	169

LIST OF FIGURES

- Figure 1.1: Global operational Model of Electricity Industry
- Figure 1.2: Power Consuming Sectors
- Figure 1.3: Sector Wise Energy Consumption (2000-01 and 2005-06)
- Figure 1.4: Trend in Power Consumption be sector (2000-01 to 2006-07)
- Figure 1.5: Per Capita Consumption of Power (from 1980-2007)
- Figure 2.1: Major Thermal Power Plant
- Figure 2.2: Location Map for Various Hydro Power Projects under NHPC
- Figure 6.1: NTPC's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.2: NTPC's Net Sales VS PAT FY 05-FY07
- Figure 6.3: NPCIL's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.4: NPCIL's Net Sales VS PAT FY 05-FY07
- Figure 6.5: NHPC's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.6: NHPC's Total Income VS PAT FY 05-FY07
- Figure 6.7: NEEPCL's PBDIT VS PBDIT margin FY04-FY06
- Figure 6.8: NEEPCL's Net Sales VS PAT FY 04-FY06
- Figure 6.9: DVC's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.10: DVC's Net Sales VS PAT FY 05-FY07
- Figure 6.11: Jaiprakash Hydro Power Limited's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.12: Jaiprakash Hydro Power Limited's Net Sales VS PAT FY 05-FY07
- Figure 6.13: BF Utilities PBDIT VS PBDIT margin FY04-FY06
- Figure 6.14: BF Utilities Total Income VS PAT FY 04-FY06
- Figure 6.15: Indo Wind Energy Limited's PBDIT VS PBDIT margin FY04-FY06
- Figure 6.16: Indo Wind Energy Limited's Total Income VS PAT FY 04-FY06
- Figure 6.17: 10kW Biomass Gasifier Plant at Chhattisgarh's PBDIT VS PBDIT margin FY04-FY06
- Figure 6.18: 10kW Biomass Gasifier Plant at Chhattisgarh's Total Income VS PAT FY 04-FY06
- Figure 6.19: Power Grid Corporation's PBDIT VS PBDIT margin FY05-FY06
- Figure 6.20: Power Grid Corporation's Net Sales VS PAT FY 04-FY06
- Figure 6.21: Reliance Energy's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.22: Reliance Energy's Net Sales VS PAT FY 05-FY07
- Figure 6.23: Tata Power's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.24: Tata Power's Net Sales VS PAT FY 05-FY07
- Figure 6.25: Power Finance Corporation's PBDIT VS PBDIT margin FY05-FY07
- Figure 6.26: Power Finance Corporation's Net Sales VS PAT FY05-FY07
- Figure 6.27: Suzlon's PBDIT VS PBDIT margin FY 05-FY07
- Figure 6.28: Suzlon's Net Sales VS PAT FY 05-FY07

Figure 6.29: Trend of Total Turnover & Exports (2002-03 to 2005-06)

LIST OF TABLES

Table 1.1:	Segment wise Power Generation (MW) as on 30 th April 2007
Table 1.2:	Summary of Installed Capacity (MW) as on 30 th April 2007
Table 1.3:	Summary of installed capacity (MW) as on 31 st Dec 2006
Table 2.1:	Major Thermal Power Plants
Table 2.2:	Projects executed during April 2005 to December 2006
Table 2.3:	Thermal Units Included in Original 10 th Plan But Slipping to 11 th Plan
Table 2.4:	Future Thermal Power Plants under 11 th Plans
Table 2.5:	Hydropower generation capacity (MW)
Table 2.6:	Potential Hydro Power Locations in India
Table 2.7:	Hydel units commissioned during FY03-FY06
Table 2.8:	Hydropower projects planned for 11 th Plan (2007-12)
Table 2.9:	Ongoing Hydroelectric projects in 11 th Plan (2007-12)
Table 2.10:	Nuclear Power Plants under Construction
Table 2.11:	Estimated Wind Power Potential in India
Table 2.12:	Installed Capacity (MW) of Wind Energy from Year 2000-2007
Table 2.13:	Wind Turbine Technologies
Table 2.14:	Major projects completed: Wind Energy
Table 2.15:	Ongoing projects at a glance: Wind Energy
Table 2.16:	Estimated medium-term potential and cumulative achievements as on 31 st March 2007
Table 2.17:	List of solar projects completed in recent past
Table 2.18:	List of projects currently being executed
Table 2.19:	Interest subsidy: Bagasse Co-generation (Commercial Projects)
Table 2.20:	Interest subsidy: Biomass Power
Table 2.21:	Completed Biomass projects
Table 2.22:	Ongoing Biomass projects
Table 3.1:	Details of lines as on 30 th April 2007
Table 3.2:	Details of Transmission Lines and Sub- Stations under construction as on 30 th April 2007
Table 3.3:	State-wise AT&C Losses as on December 2006
Table 4.1:	Demand as per National electricity Policy
Table 4.2:	Demand as per National electricity Policy
Table 6.1:	NTPC's Projects in Operation
Table 6.2:	NTPC's Projects under implementation
Table 6.3:	NPCIL's Power Projects under operation
Table 6.4:	NPCIL's Power Projects under construction

Table 6.5: NHPC's Power Projects under operation
Table 6.6: NHPC's Power Projects under construction
Table 6.7: NHPC's Power Projects awaiting clearance
Table 6.8: NHPC's Power Projects under Survey and Investigation Stage
Table 6.9: Projects of NEEPC in operation
Table 6.10: Projects of NEEPC under construction
Table 6.11: DVC's Projects in Operation
Table 6.12: Capacity Addition of DVC in 2007
Table 6.13: Proposed Projects of DVC
Table 6.14: Projects Approved by Power Grid Corporation of India in 2004-05
Table 6.15: Projects Approved by Power Grid Corporation of India in 2005-06
Table 6.16: Generation Projects Executed in India by Reliance Energy
Table 6.17: Transmission Projects Executed in India by Reliance Energy
Table 6.18: EPC Projects Executed in India by Reliance Energy
Table 6.19: EPC and Contract Projects Executed Abroad by Reliance Energy
Table 6.20: Projects Executed in India by Tata Power
Table 6.21: Projects Executed abroad by Tata Power
Table 6.22: Re-powering/ Capacity Augmentation Projects in India by Tata Power
Table 6.23: Receiving Stations /Sub-Station Projects (in-house & abroad) by Tata Power
Table 6.24: Transmission & Distribution projects by Tata Power
Table 6.25: Power plant Management/Operation by Tata Power
Table 6.26: Projects Funded by PFC
Table 7.1: Status of Reforms in different costs
Table 8.1: Special Purpose Vehicles
Table 8.2: Allocation of Power to UMPP
Table 9.1: States with Highest Peak Shortages and Corresponding T&D losses
Table 9.2: Demand supply Scenario of Power in India