Workshop on HELE Coal Technologies

Indian Technology Initiatives
&
Future Challenges

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Country Overview

- Developing economy
  - GDP growth rate of about 8-9%
- Power shortages
  - Energy & peak shortages of about 6 to 10%
- Rapidly expanding power sector
  - 11th Plan (2007-12) ~62 GW
  - 12th Plan (2012-17) ~80 GW
  - 13th Plan (2017-22) ~100 GW
- Pursuing eco-friendly development path

Coal at The Centre Stage

- Being Abundantly available indigenously, Coal will remain the main fuel for power
- Indian coal - High ash content, Slow burning, & Highly abrasive ash.
- PC technology – the current workhorse perfected gradually through learning curve
- Any new technology for India must cope up with realities of Indian coal

Policy Initiatives For Clean Power

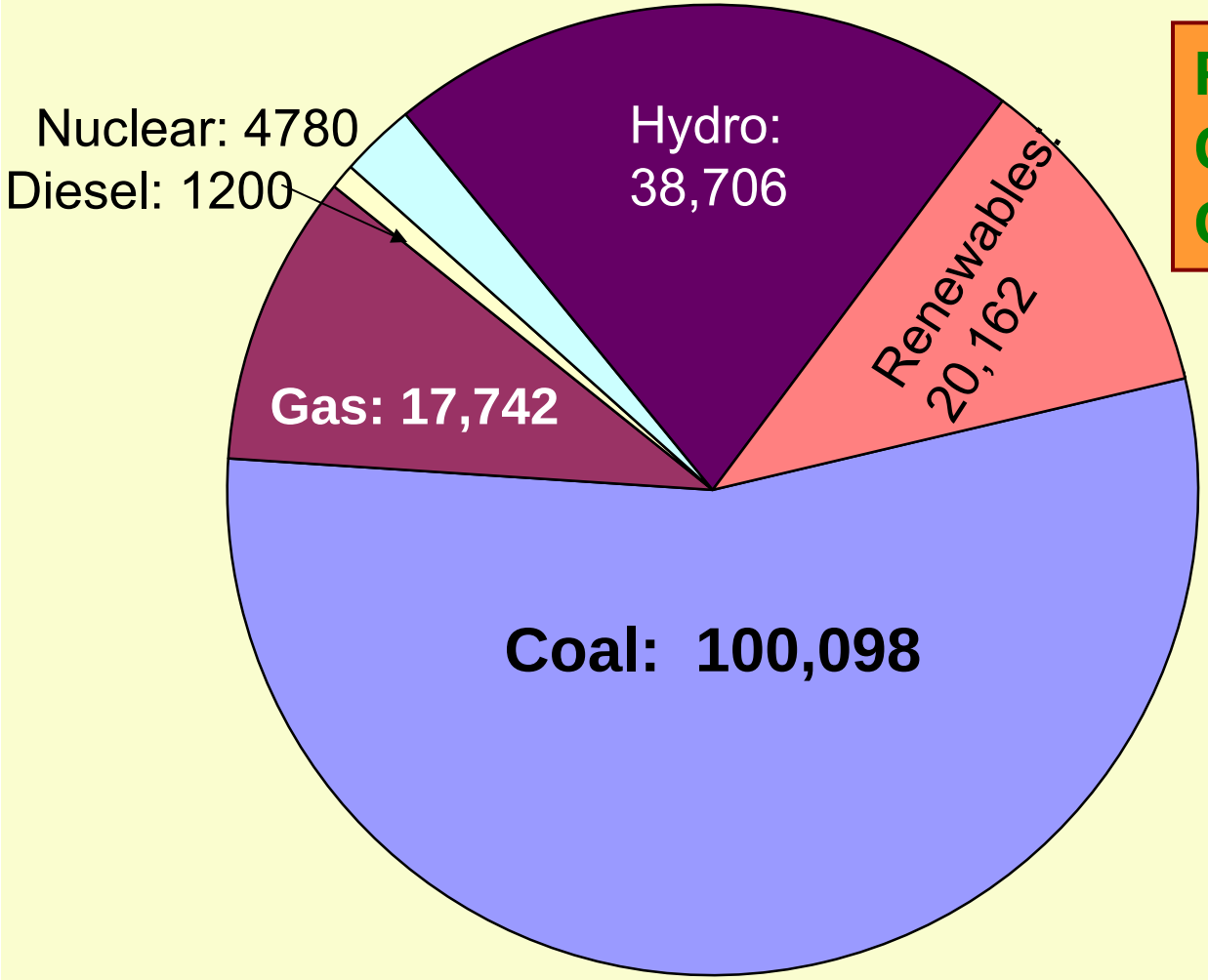
- **Energy conservation and demand management**
  - National Mission on Enhanced Energy Efficiency
  - PAT (Perform Achieve & Trade) mechanism
  - End Use Efficiency (Appliance Labeling Standards, Energy Efficient buildings, CFL lamps etc.)
- **Priority to GHG free generation**
  - Thrust on Renewables & Hydro
  - Expediting statutory clearances & Implementation for Hydro Projects
  - Obligatory Renewables Purchase Obligations & trading provisions of REC
  - National Solar Mission – 1000 MW Grid Connected Solar by 2013

Policy Initiatives For Clean Power

- **GHG Reduction in Generation from Fossils**
  - Preference to Gas over coal
  - Introduction of Advance Technologies- Supercritical
  - CEA regulations on plants with mandatory minimum efficiency
  - R&D for technology development- A-USC, IGCC
- **R&M or Selective Retirement of old units**
  - Targeting large no of 200/210 MW Units LMZ designs
  - 5 – 7% improvement envisaged

Power Sector Development

INSTALLED CAPACITY..MW



Renewables: 11%
GHG Free : 34.8% Capacity

Total Installed Capacity = 182,689 MW

As on 31-10-2011

Major Unit Sizes and Steam parameters

Size	Steam Par.	Eff.	Year	Cap.
MW	ata/C/C	(%)		MW
30-50	60/ 482	~31	1950s	4400
60-100	90/ 535	32-33	1960s	
110 to150	130/ 535/535	35-36	1970	12000
200/210	130,150/535/535	36.3,37.8	1977	35000
250	150/535/535	38.3	1995	11000
500	170/ 538/538	38.5	1984	28500
500	170/535/565	38.7	2010	
660	247/535/565	~39.5	2010	2000
660/800	247/565/593	40.5	-	

Efficiency - Gross on HHV

Total Coal Capacity- **100,098**

Supercritical Unit Sizes

Unit Size (MW)	Parameters	Design Efficiency * Gross on HHV
660	247kg/cm^2 538/565 ^{O} C	39.5 %
	247kg/cm^2 565/593 ^{O} C	40.5 %
800	247kg/cm^2 565/593 ^{O} C	40.5 %

Expected Efficiency Gain of ~ 5% over Present 500 MW Units (170 kg/cm^2 535/535 ^{o}C)

Supercritical technology in India - Historical Perspective

- **Periodic Reviews of Technology needs by MoP & CEA**
  - Expert Committees/Subgroups – 1986, 1990
- **CEA Expert Committee -2001**
  - Optimal Unit Size & Supercritical Steam Cycle Parameters
- **Issues considered by The Committee**
  - Global scenario- Technology, Unit sizes & operating experience
  - Country's Capacity addition programme
  - Power System capability & grid related issues
  - Steam parameters, Cycle configuration & Cost economics
  - Environmental & Cost benefits
  - Indigenous capacity building
    - **Manufacturing, Transportation, Human Resource**
  - Strategy for technology induction

Expert Committee Recommendations

- Supercritical a matured technology
  - Large Numbers Operational Reliably worldwide
- Seed capabilities for introducing Supercritical Units exist in the Country
- No grid constraints for units upto 1000 MW
- Units of 800 to 1000 MW should be adopted
- Higher steam temperatures of 568 ^{o}C to 593 ^{o}C
  - Depending on site specifics economics

---Contd.

Expert Committee Recommendations – Issues to be addressed

- Operating Practices And Skills Improvement To Achieve Design Performance
- Reliable And Proven Technologies and Stringent Quality Control at each Stage for Quick Stabilization
- Efforts to rapidly indigenize manufacturing
- Bulk order of 8-10 Units for rapid indigenization and lower cost
- Adequate measures for supply of consistent/good quality Coal
- Group to evolve basic design features of Supercritical units optimized for Indian conditions

Supercritical Technology Progress & Plans

- First Supercritical unit of 660 MW Commissioned in Dec-2010
- 4 Units with total capacity 2640 MW operating
- ~ 4000 MW supercritical capacity to be operational in 11th Plan (March -2012)
- Supercritical to constitute 50-60% coal fired capacity addition in 12th Plan (2012-17)
- 100% coal fired capacity addition in 13th Plan and beyond to be supercritical

Promoting Supercritical Technology

- Preference to supercritical units in coal allocation
- Promoting indigenous manufacturing for super critical equipment
- Bulk orders for Super Critical units with Phased Indian Manufacturing
  - **11x660 MW Bulk order for NTPC and DVC**
  - **9x800 MW for NTPC**
- Why Requisite Indigenous Manufacturing Capacity
  - **Considerably Aid Lifetime Support For Services/Spares**
  - **Know How & Know Why**
  - **Specific Problem Solving & Customization**

Indigenous Manufacturing Capacity Building

- **BHEL Technology tie ups for supercritical Tech**
  - Boiler - Alstom, TG - Siemens
  - Capacity Augmentation – Up to 20,000 MW
- **New Joint Ventures for Supercritical units**
  - Supercritical Boiler ~ 14000 MW +
  - Supercritical TG ~ 15000 MW +
  - More Joint Ventures in the pipeline
- **International manufacturers involved**
  - MHI Japan, Toshiba, Alstom, Ansaldo, Hitachi, Babcock Hitachi

The Road Ahead – Performance

- **Performance Objectives**
  - Availability
  - Efficiency
  - Safety
- **Determinants of Performance**
  - Design & Sizing
  - Supply & Construction
  - Quality Control
  - Operation & maintainance
  - Trained man power, spares and services, standard operating procedures
- **Advancements/Improvements**
  - Project implementation & Operation

Design & Sizing

- Appropriate designs for Indian conditions
  - **Furnace sizing – Indian Coal/Blended Coal**
  - **Range of coal quality including blending**
  - **BFP configurations –**
    - MDBFP Vs TDBFP,
    - Size & Nos
  - **Fans Type- Axial vs. Radial**
  - **APH – 4 Bi Sector Vs. 2 Trisector**
  - **By Pass System Sizing**
- Common Acceptable Criteria being Evolved
  - **Utilities, Manufacturers and Consultants on D&E Philosophy**
- "Standard technical features of Supercritical units" being developed by CEA – Draft Under Discussion

Erection and Commg

- **Transport of Heavy Equipment**
  - Specially for higher size units 800 MW and above
  - Constraints in Rail transportation & Ports
- **Implementation Schedules**
  - Current 48 months for 660 MW
  - Explore Possible optimization
- **Areas Needing Attention**
  - Equipment /machinery/infrastructure required for faster project implementation
  - Standard Optimal Schedules

High Efficiency Technology Options

High Efficiency .. Indian Context

- High CW temperature 33 -36 deg C
- High Ambient temperature
- Poor Coal Quality
  - **High Ash**
  - **Slow burning**
  - **Abrasive**

➡ High Heat Rate (Low Efficiency) & High Aux Power

➡ Estimated impact - ~ 2-4 percentage points

Efficiency Computations made on **Gross Generation** and **GCV** of Coal

Pre-Requisites for Technology Adoption

- Proven and Mature Technology
  - Demonstrated Successful & Reliable Operation
    - Commensurate Scale & Operating Conditions
- Requisite Availability of Suppliers
- Tangible Potential Benefits
- Sound Well Adapted Designs
- Core manufacturing, Implementation & Service Support Arrangements
- Technoeconomics
- Phased & Structured Introduction

Equipment Quality/Performance

- **Appropriate Design/Sizing important for Performance**
- **Suitability of equipment for specific site to be ensured**
- **Indian Design Practices**
  - Emphasis on Reliability
  - Conservative Designs with adequate margins
  - Varying Ambient Conditions
  - Frequency Variations
  - Indian Coal Characteristics
  - Maintainance Provisions

The Road Ahead on Technology

- Quest for Higher Efficiency is Ongoing & Continuous
- Options for High Efficiency
  - **Supercritical Technology**
  - **Ultra supercritical Technology**
  - **Advanced Ultra supercritical Technology**
  - **IGCC**
  - **Coal Beneficiation**
- CFBC

Technology Options

- Supercritical Technology
  - **Already Adopted**
- Ultra supercritical (USC) technology
  - **International Experience ~ 280 bars 600 deg C.**
  - **Experience limited mainly in Japan, Europe and few countries**
  - **International Developments under watch**
  - **Higher Steam Parameters Contemplated Based On Feed Back Of Operating Supercritical Units**

Technology Options

- Advance Ultra Supercritical Technology
  - Efforts underway for indigenous development of 700 deg C technology
  - MoU between IGCAR, NTPC & BHEL
  - Indigenous design and manufacturing of materials proposed
- Circulating Fluidised Bed Combustion (CFBC)
  - Being Adopted for High Sulphur Lignite
  - Several 125 MW units operational
  - 250 MW CFBC units being installed

IGCC

- Limited International experience & with low ash coals
- Fluidised bed gasifier considered suitable for Indian coals not proven Internationally
- High Capital and operating Cost
- IGCC technology for Indian coal requires indigenous development through R&D
  - **Feasibility studies done by Nexant, USA & BHEL**
    - **Indicate Low efficiency and low availability**
  - **BHEL MOU with APGENCO for IGCC demo project**
  - **NTPC desirous of setting up IGCC demo plant through International cooperation**

Coal Beneficiation

- Indian coal – high ash 40-45%
- Open cast mining → Impurities
- Coal Beneficiation - Benefits
  - Savings in Transport cost
  - Better use of Transport infrastructure
  - Advantages in O&M
- Issues
  - Low Washing Yields
  - Problem of Rejects Disposal/use

Presently Washing Has Been Found Economical For Load Centre Stations

To Conclude

- Impressive Start on Supercritical Technology
  - Large number of units under construction
- Efforts of Indigenous Capacity Building Bearing Fruits
  - Several International manufacturers setting manufacturing Facilities in India
- Efforts to improve Project Implementation Timelines & Remove Infrastructure Bottlenecks Continuing
- Optimal Design & Performance is Need Of The Hour
- Preparedness and Desire for Further Technology Improvement & Indigenization
  - Ultra Supercritical On the radar
  - National R&D for Advance Ultra Supercritical Technology & IGCC

THANKS

For More Information

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