

# **Asia-Pacific Partnership on Clean Development & Climate (APP) Power Generation and Transmission Task Force**



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# APP Power Generation & Transmission Task Force

## Major task statements:

- Identification and implementation of applicable best practices for:
  - Power Generation (coal, wind, and hydro)
  - Transmission & Distribution
  - Demand Side Management
- Information sharing consistent with clean development and climate change

# Opportunities for Coal Power Plant Improvement Implementation of Best Practices

- Significant opportunities in ALL countries
  - IEA/G8 Gleneagles Plan of Action analyses showed global potential to reduce 1.35 - 1.7 billion tons/yr of CO<sub>2</sub> by moving to state-of-the-art plants, which could reduce coal consumption by ~0.5 billion tons/yr
  - Report being prepared: *Coal-Based Power Generation - Efficiency reporting, Ongoing developments, and Outlook*
    - At present, there is no formal, common mechanism for collecting and compiling coal-fired plant efficiencies and specific CO<sub>2</sub> emissions from the different regions of the world.
    - Defining an all inclusive methodology for the rationalization of reported plant efficiency values from different plants in different regions, calculated and expressed on different bases and using different assumptions, is not a practical proposition.

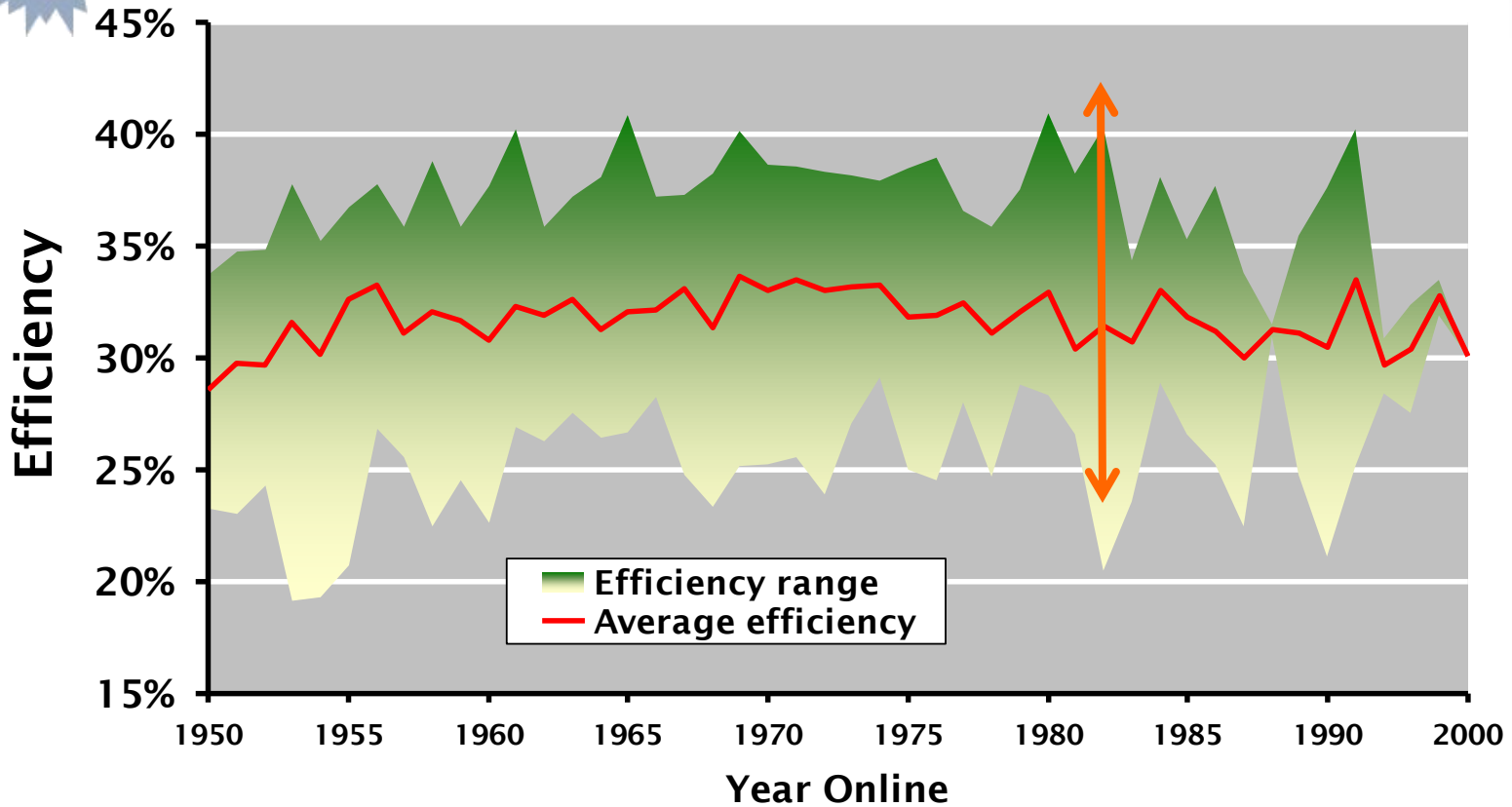
# Opportunities for Coal Power Plant Improvement Implementation of Best Practices

- USDOE/NETL analyses (July 2008) showed:
  - U.S. average coal-fired power plant efficiency is 32% compared to top 10% average of 37% and ~39% for new supercritical pulverized coal plant
  - for given online year, range between highest and lowest plant efficiency is 20 percentage points
  - possible 250 MMmt CO<sub>2</sub> per year could be avoided if all plants could achieve performance of top 10%

# U.S. Coal-Fired Power Plant Efficiency Has Not Improved Over Last 50 Years

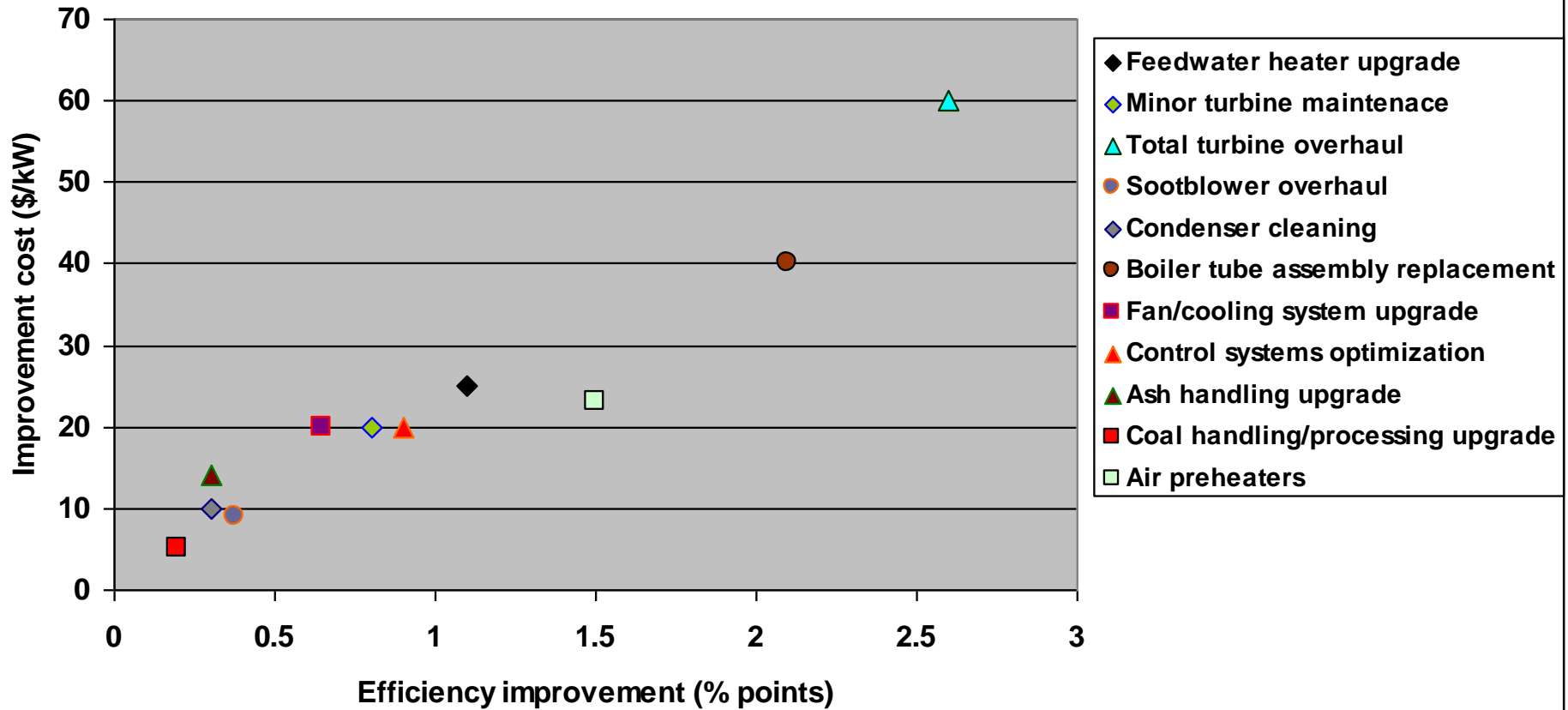


## CFPP Average Efficiency and Range for 2007



# How much do these improvements cost?

Cost of power plant efficiency improvement projects



# Flagship Coal Power Generation

## Best Practices PGT-06-01: Inaugural Site Visit

- **First event held in Fall 2006 hosted by American Electric Power (AEP)**
- **100 attendees from 6 inaugural APP nations**
- **High-level AEP corporate and U.S. government participation**
- **Two technology tracks**
  - Existing Plants – Discussed best practices for efficiency and O&M at two AEP power plants
  - Advanced Power Generation
    - Discussed AEP's plans for new ultra-supercritical p.c. and IGCC power plants
    - Visited DOE's/Southern Company's Power Systems Development Facility and Tampa Electric 's 260-MW IGCC Polk Plant
    - Met with all major IGCC technology providers (GE, GTI/Synthesis Energy, Shell, and Siemens)



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## Best Practices PGT-06-01: Peer Reviews



### ■ Japanese Peer Review

- ~50 participants from 40+ different organizations from 6 inaugural APP countries visited 3 Japanese power during 16-19 April 2007
- Reviewed best practices for power plant efficiency and O&M; developed efficiency improvement check list and power plant design and operations handbook (“Green Book”)



### ■ Indian Peer Review

- 150 participants from all 6 inaugural APP countries visited NTPC’s National Capital Thermal Power Project at Dadri, and Rajasthan’s Kota Thermal Power Station in February 2008
- Reviewed operations using checklist developed during Japanese Peer Review; identified opportunities for efficiency improvement



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## Best Practices PGT-06-01: Peer Reviews



### ■ U.S. Peer Review

- 90 participants from China, Japan, India, Korea, and USA visited Alliant's Edgewater and Columbia power stations (April 28-May 2, 2008)
- Reviewed operations using checklist



### ■ Australian Brown Coal Peer Review

- Visited Loy Yang and Hazelwood power plants in Latrobe Valley during 23-27 June 2008
- Provided forum to openly discuss/exchange information on unique challenges and technology and/or process enhancements to brown coal efficiency improvements and opportunities to reduce overall emissions
- Built on experiences and lessons from previous site visits by improving checklist, but focused on brown coal



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## Best Practices PGT-06-01: Peer Reviews

- **Korea Peer Review**
  - Delayed until 6-10 July 2009 in Seoul, Korea
  - Hosted by Korean Western Power Company, Ltd. and Ministry of Knowledge and Economy
  - Anticipate more than 50 participants from all seven APP partner countries
  - Site visits
    - Yonghung Power Plant (3,200 MW supercritical, largest power plant)
    - Seoinchon CCPP (3,600 MW combined-cycle plant)
    - Seoul Power Plant (combined heat and power plant )
- **China Peer Review – proposed by China Guodian late 2009 or early 2010**



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## Best Practices PGT-06-01: Indian State Utilities

- Builds upon foundation of 14 years of technical assistance under USAID's Greenhouse Gas Pollution Prevention (GEP) Project to improve performance of Indian coal power plants. Under GEP:
  - With NTPC, established Centre for Power Efficiency & Environmental Protection (CenPEEP) and two regional CenPEEPs for outreach across NTPC fleet and to state utilities throughout India
  - Provided basic power plant diagnostic/testing equipment for each CenPEEP
  - 25+ visits by U.S. experts conducted 200+ demonstrations and providing 7,700+ man days of training
  - CenPEEP conducted more than 130 workshops, 14,500 man days of training, and 325 hands-on demonstrations
  - **Conservatively avoided total of ~90 million tons of CO<sub>2</sub> emissions**



NTPC's Dadri  
Power Plant

CenPEEP received USEPA's  
Climate Protection Award in  
2003



# Flagship Coal Power Generation

## Best Practices PGT-06-01: Indian State Utilities

- Extend NTPC/CenPEEP's know-how and successes to coal-fired power plants operated by state utilities
  - Three coal plants selected: Ropar in Punjab, Kolaghat in West Bengal, and Tuticorin in Tamilnadu
  - Basic power plant diagnostic/testing equipment provided to CenPEEP, Ropar, and Kolaghat, and eventually to Tuticorin
  - State utilities and CenPEEP engineers visited U.S. power plants to observe efficiency improvement activities and best practices
  - Combustion optimization tests performed at in one unit each at Ropar and Kolaghat
  - ***Identified potential to regain 3-5% efficiency improvement & lost 30 MWs at Kolaghat and several percentage points at Ropar***
  - CO<sub>2</sub> emissions reduction:
    - ***Ropar – 625,734 tonnes/year (all 6 units); 44,699 tonnes/year already achieved***
    - ***Kolaghat – 254,004 tonnes/year (all 6 units); 39,688 tonnes/year already achieved***
  - Similar activities will be carried out at Tuticorin in late 2009

# Flagship Coal Power Generation Best Practices PGT-06-01: Electrostatic Precipitator Performance Improvement



- Particulate emissions are significant environmental problem in Indian power sector
  - plants designed for better quality (i.e., lower ash) coals
  - lack of sufficient maintenance
- Demonstrate effective operations and maintenance (O&M) procedures/practices and equipment to significantly improve electrostatic precipitator (ESP) performance that will reduce coal-fired power plant particulate matter emissions
- Conducted on one ESP at Tamilnadu Electricity Board's Tuticorin Thermal Power Plant
  - March 2008 – Pre-inspection visit
  - July 2008 – Full inspection yielded two recommendation lists:
    - capital intensive repairs & replacements
    - low-cost O&M procedures and components
  - Final report delivered in April 2009 (to be posted to CEA's website)

# Flagship Coal Power Generation Best Practices PGT-06-01: India Next Steps



- DOE/NETL, USAID-India, and NTPC collaborating to identify new technology and O&M demonstration projects to implement under the GEP and APP programs
- Activities being developed include:
  - Demonstration of air heater overhaul to provide maximum operating efficiency and sustain optimum plant heat rate
  - Coal pulverizer performance enhancement through component upgrade to increase capacity, fineness, lower emissions, and eliminate coal pipe imbalance
  - Training and workshop on high-energy piping inspection and non-destructive evaluation techniques (i.e., for new supercritical plants)
  - Outreach workshop to share results of initial work with state utilities
- NTPC proposed “model power plant” to demonstrate all best practices in one plant to show what is really possible
  - opportunity to work with Japan?

# Flagship Coal Power Generation

## Best Practices PGT-06-01: Efficiency Improvement

### Quantification Protocols and Tools

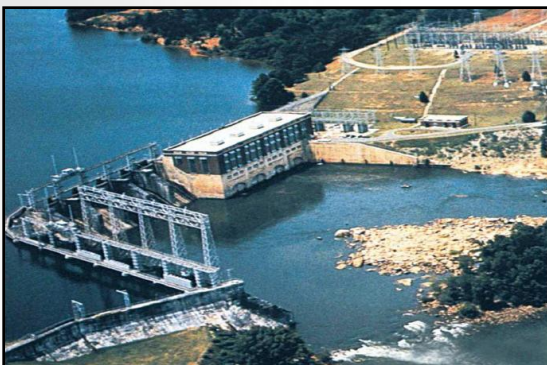
- Develop GHG emissions quantification protocol, based on Australia's NSW *Performance Improvement Testing Regime (PITR) Guidance Document*, to characterize efficiency improvements in Chinese power plants resulting from operational and/or design changes
- Principals are:
  - DOE/NETL
  - SAIC – U.S. scientific and engineering consulting company/NETL technical support contractor
  - Thermal Power Research Institute – owned by five major Chinese Gencos
  - Booz & Co – Australian global management consulting firm
  - Greenhouse Gas Reduction Scheme (GGAS) – one of world's first mandatory GHG emissions trading schemes
  - Australian power stations that have implemented NSW *PITR Guidance Document*

# Flagship Coal Power Generation

## Best Practices PGT-06-12: Application of Plasma Ignition Technology in Power Generation

- Guodian Yantai Longyuan has ~500 installations in China, mostly 300- and 600-MW units firing variety of coals; 1<sup>st</sup> foreign sale to Korea's 560-MW Samchonpo Power Plant with additional sales to Korea, Taiwan, and Russia
- Visits by NTPC (India) in January 2007 and by Guodian to Alliant in May 2008 following U.S. Peer Review
- Evaluation for application in U.S. coal-fired power plants:
  - Data collection
    - Detailed questionnaire sent to China for completion by Guodian
    - Visited igniter manufacturing facility and 2 power plants in April 2008
  - Phase I: General engineering assessment and cost estimation for both new and retrofit applications
  - Phase II: Case studies of potential energy and economic savings for two U.S. coal-fired power plants
  - Phase III: Possible cooperation with U.S. utility interested in demonstrating plasma ignition technology as a retrofit

# Power Generation Best Practices PGT-06-06: Hydroelectric Generation



- Duke Energy and First Energy led August 2007 event with coordination by Edison Electric Institute
- 50+ participants from China, India, Japan, Korea, and United States
- Visited conventional and pumped storage facilities in North Carolina, South Carolina, and New Jersey
- Discussing possible follow-on activities

Duke Energy's 17-MW Wylie Hydro Plant

# Power Generation Best Practices: Wind Electric Generation

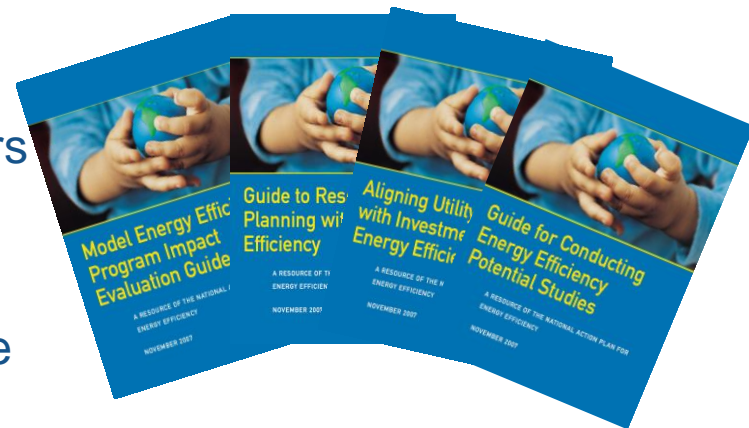


- ~50 participants from Canada, China, India, Japan, Korea and United State met during 2-6 March 2009, in San Francisco, CA
- Initial information exchange from differing perspectives of purchaser, operator/developer, and integrated system operator
- Hosted by PG&E and NextEra Energy Resources in cooperation with Edison Electric Institute
- Jointly conducted with APP Renewable Energy & Distributed Generation Task Force



# DSM Best Practices PGT-06-02: Promoting Clean Energy Options in the Electricity Supply and Demand Sector in India

- DOE's Lawrence Berkley National Laboratory (LBNL) led activity
  - Use lessons learned from U.S., especially California, to explore approaches to overcome institutional, regulatory, and procedural barriers to energy efficiency in India
  - Begin in Maharashtra as it seeks assistance on most productive ways to utilize about \$25 million of public benefits charge funds
    - Training workshop at Tata Power Company during 14-18 March 2008
    - Provide technical assistance and training to electricity regulatory commissions, public and private utility companies, consumers, and equipment manufacturers
    - Target investments in appropriate supply and demand side options
    - Design, implement, monitor, and evaluate DSM policies and programs



Some of the information shared  
at Mumbai Workshop

# DSM Programs and Load Research in Maharashtra

- Status
  - Current peak demand ~19 GW, is projected to increase to 25 GW in next 5-6 years
  - Current electricity peak shortage in March 2008 was about 4.8 GW – large opportunities for savings
  - Maharashtra Electricity Regulatory Commission (MERC) approved \$25 million DSM budget for FY08-09 for four utility companies
  
- LBNL Plan for DSM program in Maharashtra
  - Assistance to MERC on regulatory policies (DSM cost recovery, utility incentives for DSM, regulatory guidance)
  - Assistance to Maharashtra electric utility companies to implement quick-win DSM programs, load research and integrated resource planning, monitoring and verification

# Promoting DSM Programs in Delhi

- Advantages of promoting DSM in Delhi
  - Current peak demand ~4 GW, is projected to almost double over next 5-6 years, large opportunities for savings
  - Initiatives in Delhi receive national attention – expanding to other states becomes easier
  - Well-managed electricity sector with mostly private utilities that could move rapidly on DSM
  
- LBNL Plan for DSM promotion in Delhi very similar to efforts in Maharashtra

# Expanding the DSM Initiative Nationally in India

## Strategies:

- Leverage regulatory precedence related to DSM and quick-win DSM experience in Maharashtra and Delhi
- Reach out to other state electricity regulatory commissions (SERCs) in cooperation with Forum of Regulators (SERC Chairpersons only) and Forum of Indian Regulators
- In cooperation with SERCs, build capacity in public and private utilities and related stakeholders in other states on DSM implementation and load research
- Develop standardized DSM policies and programs that can be implemented nationally through the SERCs and Bureau of Energy Efficiency (BEE)

# Distribution/DSM Event

- Convened 27 April to 2 May 2009 in Raleigh, NC, and San Francisco, CA, by Progress Energy, Pacific Gas and Electric, and LBNL, with support from Edison Electric Institute
- Technical information exchange and identification of best practices associated with planning, implementation and operation of distribution systems and associated DSM programs
- Drew >50 participants from all seven APP member countries
- Smart grid standards, DSM tool kits, training on DSM processes, reduction of technical line losses, advance metering, disaster recovery, customer service, etc. identified as areas of interest



# Summary



- Updating Action Plan
- Significant progress has been made in the past 2 years by APP Power Generation and Transmission Task Force, especially on:
  - sharing of best practices
  - hands-on training and assistance to Indian power plants for efficiency improvement
- Will continue to build upon our early successes, and work to refine and expand our Best Practices efforts in the power sector of all APP member nations

## For More Information

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