NETRA
NTPC Energy Technology Research Alliance

WELCOMES
Participants of Webinar
On
Accelerating Clean Energy Innovation in India

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The Ministry of Power is primarily responsible for the development of electrical energy in the country.

The Ministry is concerned with perspective planning, policy formulation, processing of projects for investment decision, monitoring of the implementation of power projects, training and manpower development and the administration and enactment of legislation in regard to thermal, hydro power generation, transmission and distribution.
Majority of Research on Clean Coal Technologies /Clean Energy is being done by NTPC-NETRA
Mission Innovation – Accelerating the Clean Energy Revolution

Focus Areas

Climate Change & Environment Protection
- CO₂ Capture and Utilization
- Bulk Ash Utilization
- Waste Management

Clean Coal Technologies
- Advance Ultra Super Critical
- Clean Coal Technologies
- Condition Monitoring of Transformers
- Failure Investigations & NDE
- Corrosion & Water Treatment
- Vibration Analysis
- Coal analysis

Renewable Energy
- Solar PV
- CSP and CPV
- Low Energy Nuclear Reaction
- Energy Storage
- Renewable Integration
- Low Temp Waste Heat Recovery
- CFD Analysis
- Nano Technologies
- Adv Control and Automation

Energy Efficiency
- CFD Analysis
- Renewable Integration
- Low Temp Waste Heat Recovery
- CFD Analysis
- Nano Technologies
- Adv Control and Automation

Advance Scientific Support
- Vibration Analysis
- Coal analysis
**Focus Areas - Climate Change & Environment Protection (CO₂ Capture & Utilization)**

**Development of Modified Amine for CO₂ capture**

<table>
<thead>
<tr>
<th><strong>Salient details:</strong></th>
<th><strong>Benefits:</strong></th>
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<tbody>
<tr>
<td>• CO₂ absorbed in Mono Ethanol Amine (MEA) at 40-45°C (Col #1)</td>
<td>• Energy efficient CO₂ separation</td>
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<tr>
<td>• CO₂ desorbed using steam at 120-125°C (Col #2)</td>
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**PSA based CO₂ separation Pilot scale**

<table>
<thead>
<tr>
<th><strong>Salient Details:</strong></th>
<th><strong>Benefits:</strong></th>
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<tbody>
<tr>
<td>• Adsorption materials &amp; Lab scale PSA process developed</td>
<td>• Techno economical CO₂ capture from flue gas</td>
</tr>
<tr>
<td>• Phase-I: DPR for set up of PSA based CO₂ capture pilot plant in coal fired station</td>
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<tr>
<td>• Phase-II: Installation of pilot plant &amp; process optimization</td>
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**CO₂ Utilisation through Algae**

<table>
<thead>
<tr>
<th><strong>Salient Details:</strong></th>
<th><strong>Benefit:</strong></th>
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<tbody>
<tr>
<td>• CO₂ sequester capacity of algae – 200% of its weight</td>
<td>• Utilisation of CO₂</td>
</tr>
<tr>
<td>• Algae may contain bio-oil up to 30% by weight</td>
<td></td>
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<tr>
<td>• CO₂ in flue gas can accelerate algae growth</td>
<td></td>
</tr>
<tr>
<td>• Setup race way open pond pilot plant - 20 &amp; 50Sq.M</td>
<td></td>
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</tbody>
</table>
Focus Areas - Climate Change & Environment Protection (Bulk Ash Utilization)

### Setting up of Light Weight Aggregate (LWA) Plant

**Salient Details:**
- The Established technology
- Utilizing the fly ash in an eco-friendly manner
- The alternate to stone aggregates

**Benefits:**
- Bulk Fly ash utilization for NTPC stations
- Light in weight
- Conservation of precious natural resource

### Developing Cement Free Green Concrete - conversion of Fly Ash into Geo-Polymers and Construction of Road

**Salient Details:**
- University of Melbourne, Australia - 100% use of fly ash with additives without cement requirement
- Developing Cement Free Green Concrete

**Benefits:**
- Bulk Fly ash utilization for NTPC stations
- Conservation of Environment

### Use of Bottom Ash as replacement of fine aggregate (sand) in cement concrete

**Salient Details:**
- Replacement of conventional sand by bottom ash in concrete mixes.
- Casting & Testing of Concrete samples as per relevant IS/ASTM/DIN/ISO method

**Benefits:**
- Bulk Fly ash utilization for NTPC stations
- Conservation of precious natural resource
**Mission Innovation – Accelerating the Clean Energy Revolution**

**Focus Areas - Climate Change & Environment Protection (Waste Management)**

**Effluent Recycling**

**Salient Details:**
- 125 m3/hr Waste water recycling
- High cost of water charges
- High water requirement by DM plant

**Benefits:**
- Step towards zero discharge.
Focus Areas – Clean Coal Technologies

Development of Advanced USC Technology

**Project objectives**
Enable Indian industries to design, manufacture and commission higher efficiency coal fired power plants with indigenous developed technology and manufacturing process.

**Initiatives and Current status**
- Development of thermal power plant with steam parameters 310 kg/cm² / 710°C / 720°C with plant efficiency of 46%
- Consortium of BHEL, Indra Gandhi Centre of Atomic Research – (IGCAR) & NTPC
- Project: 7 years (R&D – 2.5 years; Demo plant – 4.5 years)
- Benefits: 20% reduction in CO2 emission at source, 20% saving in coal consumption compared to a sub-critical plant

Other Initiatives

- ESP efficiency improvement for SPM reduction
- Use of CFD for Flue gas and particle flow analysis
- Advanced coal combustion
  - Boiler combustion studies using CFD modeling
- Drop Tube reactor
  - Design and development of Drop Tube Reactor (DTR) to evaluate coal kinetics in boiler combustion condition of heating rate.
- Coal Combustion Simulation for Boiler parametric study
1. Indigenous Development of Solar PV floaters

**Salient Details:**
- 5 kWp Pilot Setup of Floating PV with indigenous designed floaters on patented technology

**Benefits:**
- Low cost Floating PV system
- Water & Land Conservation

2. Set Up of State of Art Concentrated PV and Solar PV Laboratories

**Salient Details:**
- Installation of 53 kWp CPV system & Test Tracker
- Studies: Spectral Response, Tracking accuracy

**Benefits**
- Explore possibility of CPV system in large scale & Capacity building for PV system testing

3. Comparative Study of 1-axis/2-axis Tracker based PV System

**Salient Details:**
- Single, Dual and fixed PV with 4 kWp each with same panels
- Technology comparison for tracking system

**Summary of study:**
- Average % increase (%) kWh of Single Axis Tracking system over fixed system is 15.54 and of Dual Axis Tracking system is 22.09.
4. Development of Centralized PV Forecasting Solution

**Salient Details:**
- Day-ahead Uniform generation forecast across NTPC
- Study of fog, storm on generation forecasting accuracy

**Benefits:**
- Minimize the operational uncertainty and challenges
- Better understanding of local weather impact on solar resources

5. Indigenous Development of Robotic Dry Cleaning system

**Salient Details:**
- Dry cleaning of Solar PV panel using robotic units
- No external source of power, fully energy independent
- Self auto Cleaning
- Remotely operated

**Benefit:**
- No use of water
- Improved generation as soiling loss are minimized because of daily cleaning
Focus Areas – Renewable Energy (Solar Thermal)

6. Set Up of State of Art Solar Thermal Laboratories

<table>
<thead>
<tr>
<th>Component &amp; Prototype Evaluation Facility</th>
<th>DEFLECTOMETRY Test Facility</th>
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<tbody>
<tr>
<td></td>
<td>PHOTOGRAMMETRY Test Facility</td>
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<tr>
<td></td>
<td>Reflectance Lab</td>
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<tr>
<td>Facility</td>
<td>Solar resource assessment - Site-specific</td>
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<tr>
<td>CSP Simulation Tools</td>
<td>GREENIUS - Simulation tool for techno-economic assessment of CSP systems</td>
</tr>
<tr>
<td>(Design, Optimization and Evaluation of CSP plants)</td>
<td>STRAL - Optical design and optimization tool</td>
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<tr>
<td></td>
<td>EBSILON - Thermodynamic design and simulation tool</td>
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7. Experimental Studies in Low energy nuclear reaction (LENR) for power generation

**Salient Details:**
- World is looking for clean energy solutions to replace fossil fuels.
- 10kW new energy power packs based on exothermic interactions between Nano metallic powders (Ni, Pd) producing excess, clean and sustainable energy has been proved.

**Benefits:**
- Feasibility of a cutting edge environmental friendly technology, to retrofit operating power plants, replacing fossil based boilers with LENR boiler
- Distributed power generation source.
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Focus Areas – Energy Efficiency (Energy Storage)

1. Development of 500 W-5h Soluble Lead Redox Flow Battery (SLFB) Storage

**Salient Details:**
- Low cost grid scale battery storage
- Flow Battery with Lead acid technology, without membrane
- Project size: 500 W-5 h
- Scale up to 100 kW-5 h size (future project)

**Benefits:**
- Low cost Battery Storage

2. Study of operation of NGK’s NaS battery for Storage in Indian Condition
Focus Areas – Energy Efficiency (NaNo Technologies)

Nano-lubricant for Coal Mill Gear Box

Salient Details:
- Modified Graphene Nano additives

Benefit:
- APC reduction
- Improved Equipment & Oil life

Nano-coolant for heat exchangers

Salient Details:
- Development of nanomaterial
- Field trials in power plants.

Benefit:
- Enhanced heat transfer
- Smaller heat exchanger,
- Reduced space requirement & water conservation
**Project objectives**
To utilize waste heat of Flue gas for useful purpose, thereby achieving higher efficiency of coal fired power plants

**Salient Details:**
- Capacity: 100 TR
- Single effect Li-Br VAM
- Utilizes LT heat from FG for AC

**Benefit:**
- Waste heat utilization for air conditioning of ESP and ASPH Control Room
- Green House Gas (CFC & HCFC) free VAM based AC system.
- 50 kW less power than conventional AC system of 100TR
- Low carbon foot prints
- CFC & GHG free system
1. Flexible Coal Unit Operation

**Salient Details:**
- Assessment of unit for flexible operation and potential assessment
- Integration of condensate throttling and other solutions

**Benefits:**
- Use of thermal storage for quick increased unit output
- Unit Optimization for grid support in view of increased RE penetration

2. Installation of Phase Matching Units (PMUs) at Generating End on the Grid

3. NTPC e-Power Plant Solutions (NePPS)
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Advance Scientific Support

1. Environmental Science Lab
2. Water Treatment Tech Lab
3. Coal & Combustion Lab
4. Creep Lab
5. Electrical Lab
6. Transformer Oil Lab
7. Corrosion Analysis Lab
8. Lub Oil & Tribology Lab
9. Analytical Lab
10. NDE & Imaging Lab
11. Metallurgy & Failure Analysis Lab
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<table>
<thead>
<tr>
<th>Country</th>
<th>Collaboration Area</th>
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<tbody>
<tr>
<td>Germany</td>
<td>Solar Thermal Lab</td>
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<td>Germany</td>
<td>Concentrated PV</td>
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<tr>
<td>Germany</td>
<td>CFD modelling</td>
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<tr>
<td>Australia</td>
<td>Advance Combustion and Gasification Technologies</td>
</tr>
<tr>
<td>USA</td>
<td>Renewable, CCUS</td>
</tr>
<tr>
<td>Australia</td>
<td>Advance Combustion and Gasification Technologies</td>
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<tr>
<td>Australia</td>
<td>Bulk Ash Utilization</td>
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Mission Innovation: Accelerating Clean Energy Innovation in India
### Mission Innovation – Accelerating the Clean Energy Revolution

<table>
<thead>
<tr>
<th>Academic Institution</th>
<th>R&amp;D Institution</th>
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<tbody>
<tr>
<td>IGCAR, Kalpakkam</td>
<td>AUSC</td>
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<tr>
<td>CIPET, Chennai</td>
<td>Floating Solar</td>
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<tr>
<td>CPRI, Bangalore</td>
<td>Drop Tube Reactor, Fly ash bricks</td>
</tr>
<tr>
<td>ARCI, Hyderabad</td>
<td>Nano coating</td>
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<tr>
<td>CGCRI, Kolkata</td>
<td>Fiber Optic Sensor for APH FG temp.</td>
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<tr>
<td>IIP, Dehradun</td>
<td>CO2 Capture</td>
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<tr>
<td>IIT, Guwahati</td>
<td>CO2 Capture</td>
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<tr>
<td>C-DAC, Pune</td>
<td>Computational hardware</td>
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<tr>
<td>Jadavpur University, Kolkata</td>
<td>Transformer health assessment</td>
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<tr>
<td>AMPRI, Bhopal</td>
<td>Ash Utilization</td>
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<tr>
<td>CBRI, Rookee</td>
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Mission Innovation: Accelerating Clean Energy Innovation in India
### Mission Innovation – Accelerating the Clean Energy Revolution

<table>
<thead>
<tr>
<th>Institution</th>
<th>Research Focus</th>
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<tbody>
<tr>
<td>IIT B</td>
<td>Solar, Robotics, MEMS, Corrosion</td>
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<tr>
<td>IIT K</td>
<td>Power System Smart Grid, Sensors,</td>
</tr>
<tr>
<td>IIT D</td>
<td>Simulation &amp; Modeling, AI, CFD, Solar PV</td>
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<tr>
<td>MIDHANI</td>
<td>Development of erosion resistant component</td>
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<tr>
<td>TERI</td>
<td>Water Foot print</td>
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<tr>
<td>NCCBM</td>
<td>RCC Structure-Audit and Survey</td>
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<tr>
<td>EEC</td>
<td>ESP performance improvement using CFD Modeling</td>
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<tr>
<td>IISc</td>
<td>Process simulation, Flow Battery</td>
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<tr>
<td>NML</td>
<td>Creep Damage Assess of High Temp Headers &amp; Pipe</td>
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<tr>
<td>IOCL</td>
<td>Micro-Algae based CO₂ utilization</td>
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Thank You!

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