Industrial GHG Mitigation Strategies - 2009

Analysis of Electricity Supply Sector

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19th March 2009

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Outline

- Introduction
  - Sector Background
  - Existing Policy Framework
- Mitigation Options
- Policy Options
- Conclusion

Introduction: Sector Background

- Power sector: a major contributor to India's overall GHG emissions
- Coal will continue to be mainstay in India power generation
- Sub-critical units dominate coal based power generation
- Advanced coal technologies are being adopted:
  - Supercritical units are now coming up under the Ultra Mega Power Plant (UMPP) scheme
  - R&D on IGCC carried out by BHEL including pilot plant; 125 MW IGCC plant expected by 2011

Introduction: Existing Policy Framework

Climate Change

- **India is a signatory to the Kyoto Protocol**
  - Largest number of CDM projects registered with the UNFCCC
- **Member of Asia-Pacific Partnership for Clean Development and Climate**
- **National Action Plan on Climate Change**

Technology Policies in the Indian Power Sector

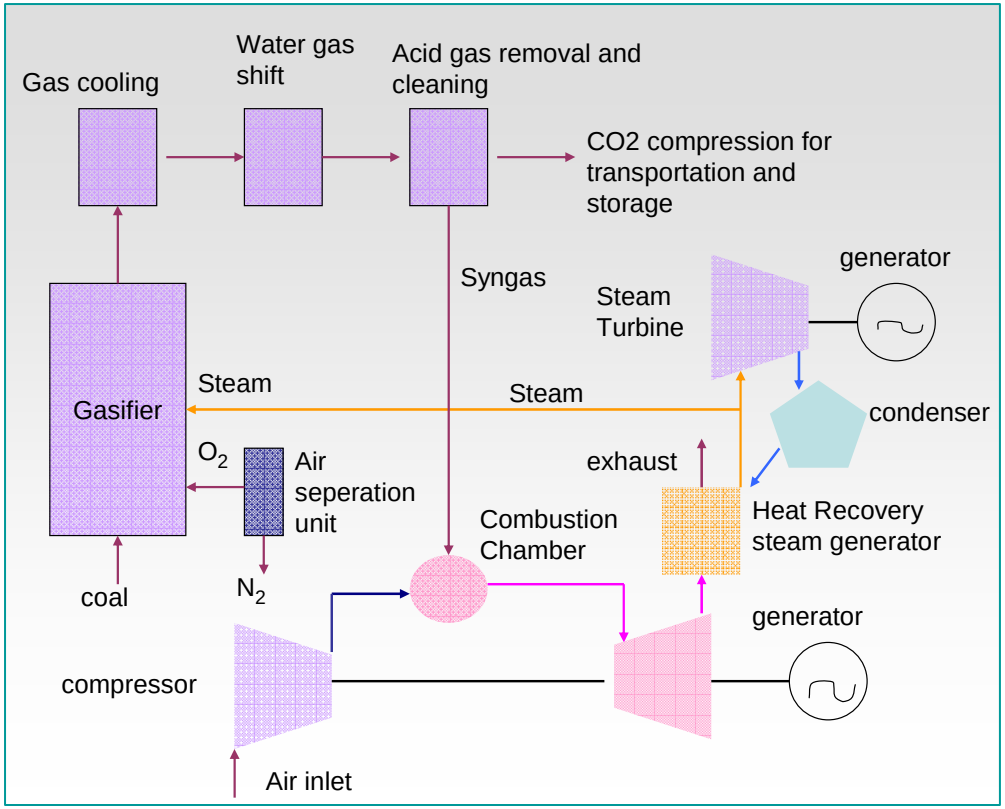
- **Previous policies: Institutional & regulatory reform in the power sector**
  - Policy support for renewable energy
  - Electricity Act 2003
- **Climate change mitigation requires technology shift with coal based power**

Wide Portfolio of Mitigation Options

- Renewables
- Advanced Coal Technologies
  - Supercritical and Ultra Supercritical Technologies
  - Integrated Gasification Combined Cycle (IGCC)
  - Circulating Fluidized Bed Combustion (CFBC)
  - Carbon Capture and Storage (CCS)
- Combined Cycle Natural Gas Based Plants
- Efficiency improvement in existing units
- And many more…

Mitigation Option: IGCC with CCS

- Integrated Gasification Combined Cycle (IGCC) plant is a combination of both combined cycle and gasification plant
- Coal is gasified into syngas, which is used as fuel in combined cycle operation
- CCS involves capturing the CO2, transportation and subsequent storage

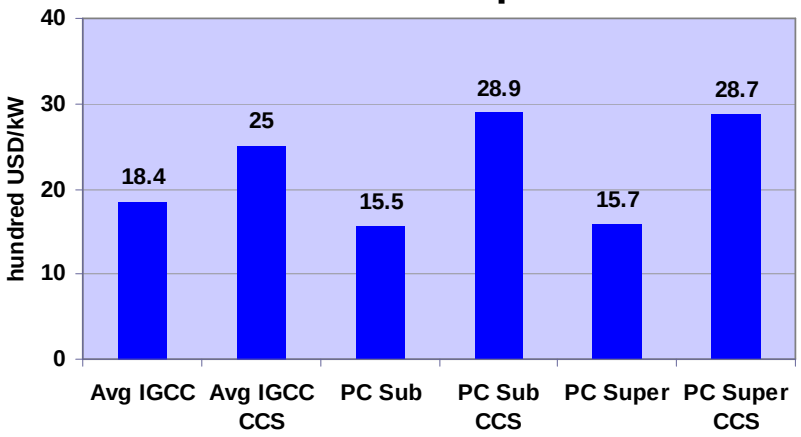


Why Plan Ahead for Carbon Capture?

- Carbon Capture and Storage (CCS):
  - Key technology for global GHG emissions mitigation efforts
  - Estimated to be globally commercial during 2020-2025
  - Expected to contribute 15-55% of world wide mitigation effort until 2100
- CCS has a high emission reduction potential but carries high costs
  - Government support needed for both R&D and demonstration projects
- Retrofit of capture technology may not be economical for older plants
  - Capacity building needed for technologies that can facilitate CCS

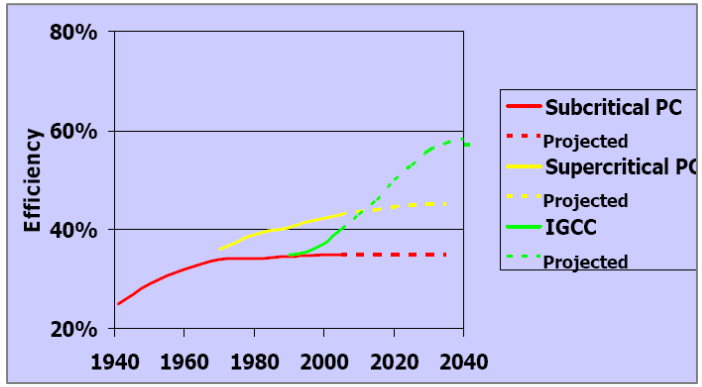
IGCC: A Good Match for Carbon Capture and Storage

Plant cost comparison



Source: National Energy Technology Laboratory (NETL) study

Present and expected efficiencies



Source: US Department of Energy

- With present day technologies, IGCC with CCS is the cheapest option
  - Option to co-produce transport fuel, chemicals, fertilizers from the syngas
  - Potential for future high operating efficiency
  - Co-benefits: low water use, low CO2 emissions, improved environmental performance

Current Status: IGCC with Indian Coal

- R&D pilot scale plant on IGCC FBGs
  - Plans to scale up to 125 MW demo plant at Auraiya
- USAID Feasibility Study on IGCC with Indian coal
  - High ash Indian coal is more compatible with IGCC based on Fluidized Bed Gasifiers (FBGs)
  - Advances in technology can increase efficiency further
  - Cost estimated to come down to US$ 1300–1400/kW under commercial conditions
- Upcoming IGCC plants with Indian coal
  - 125 MW IGCC plant in Vijaywada by BHEL and APGENCO
  - 100 MW demonstration IGCC at NTPC Dadri

Current Status: CCS in India

- Participation in international forums
  - Carbon Sequestration Leadership Forum (CSLF)
  - Participation in Future Gen project
  - UK India collaboration project on CCS
- Major ongoing CCS projects
  - Geological sequestration pilot study in west India Basalt formations
  - Identification of deep underground saline aquifiers by Department of Science and Technology (DST)
  - Feasibility study of CO_2 EOR for Ankaleshwar oil field
    - Potential to sequester 5–10 Million tonnes of CO_2

Estimated Emission Reduction Potential: IGCC with CCS

	Typical coal based plant	IGCC with CCS (90% capture)
Average net efficiency (100 MW)	29.5%	27.5%
Baseline emission coefficient (tCO2/MWh)	1.083	0.12
Total CO2 emissions for a 100 MW plant (tCO2)	758780	81396
Annual CO2 reductions for a 100 MW plant (tCO2)		**677,384**
Average net efficiency (500 MW)	33%	31%
Baseline emission coefficient (tCO2/MWh)	1.083	0.12
Total CO2 emissions for a 500 MW plant (tCO2)	3793902	403867
Annual CO2 reductions for a 500 MW plant (tCO2)		**3,390,035**

* Estimations based on conservative assumptions for IGCC efficiency and assuming 90% CO2 capture

Barriers to IGCC and CCS technologies

Barriers to IGCC

- High present capital costs
- Limited international experience on Fluidized Bed Gasifiers (FBG) based IGCCs

Barriers to CCS

- Low technology maturity
- Lack of defined international monitoring and verification framework
- High Costs
- Insufficient R&D
- Detailed understanding of environmental impacts

How to Overcome Challenges:
End Objectives of Policy Options

- Encouraging indigenous IGCC R&D specifically with poly generation and CCS
  - Help resolve pending technical issues
  - Research can help bring costs down
- Setting up demonstration plants
  - Start with economically attractive alternatives like EOR
- Detailed study of CCS with IGCC FBG technology
- Requirement of detailed geological assessment for storage purposes
- Encouraging private sector participation and long term commercialization
- International assistance can help speed up implementation

Suggested Policy Options

Mitigation Option	Policy Option	Short term (2009-2011)	Mid term (2011 – 2016)	Long term (2016 – 2021)
IGCC	Upto ~ 50% Government Grant Support for IGCC (including CCS, poly generation) demonstration and commercial Projects			
	Public Private Partnership (PPP) for commercial IGCC projects			
	Facilitate R&D in IGCC technology			
	Preferential tariffs for commercial IGCC Based Power Plants			
	IGCC can be used to meet obligation to purchase renewable/clean power by states			
	IGCC with CCS international collaborations and knowledge sharing			
	Fiscal policies including tax incentives			
CCS	Setting up of a R&D test centre			
	Establishing Tax Incentives for CCS demonstration and commercial Projects			

International Policy Support

- Technology transfer and knowledge sharing
- Development of international monitoring and verification framework for storage
- Financing mechanisms for demonstration projects (like CDM)

Conclusions

- R&D and financing support are needed for IGCC and CCS to mature into fully commercial technologies
- Suggested policy options can help to achieve long term adoption of IGCC with CCS technology in India
- International assistance and knowledge sharing is expected to play a major role

For More Information

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Open for discussion

- India's long term strategic planning for technology in coal based power generation
- Option of co-production of chemicals and power
- Other barriers (if any) in adoption of IGCC and CCS technologies
- Requirement of policy support and adequate international assistance to help address potential barriers