High efficiency low emissions coal fired power generation technology: technical developments and policy challenges

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What is the IEA Clean Coal Centre?

- We are an Energy Technology Cooperation Programme, which is endorsed by the International Energy Agency.

- We provide a means for international co-operation on clean coal related issues, and provide objective and independent information on the efficient and sustainable use of coal.

- We focus on how to use coal more effectively, efficiently and cleanly, to minimise its environmental impact while providing cost effective energy. This includes the impact of coal related policies and regulations, clean coal use technology developments and deployment, emissions control technologies and global coal markets.
What does the IEA Clean Coal Centre specifically do?

- Our output includes:
  - comprehensive assessment reports on all aspects of clean coal technology
  - webinars based primarily on the assessment reports,
  - technical workshops on key clean coal issues,
  - a major Clean Coal Technologies Conference
  - web based dissemination services

- Increasingly, we are implementing various capacity building activities in developing countries and industrialising nations, to support knowledge transfer on a wide range of coal related energy and environmental issues, particularly for power generation
Scope of presentation

- Rhetoric or reality?
- Regional differences in coal power generation markets
- Drive for HELE clean coal technology
  - Non greenhouse gas emissions
  - CO2 emissions and future links for CCS
- Policy, regulation and funding drives new technology opportunities
- China leading the way, but need to ensure the rest of Asia follows
- Future coal requirements and opportunities in the region
- Importance of CCS to complement HELE technology
**Rhetoric or reality?**

**Aspiration-Greenpeace**
- We see a different future - one built on clean, renewable energy. We believe that a 100 percent renewable energy future is not only within reach, it’s our best chance for to preserve the planet

**Projection-International Energy Agency**
- Even if adequate measures to meet the 2 degree scenario are implemented comprehensively, fossil fuels will still provide some 40% of the global energy mix

**Actions-Various multi-lateral and OECD backed banks**
- No financing for new coal-fired power projects, restricting financial support to countries that have "no feasible alternatives" to coal (World Bank)
- The promotion of high-efficiency coal-fired power plants is one of the realistic, pragmatic and effective approaches to cope with the issue of climate change (Japanese Investment Bank)
Coal and sustainability

Energy security

Environmental impact

Economic competitiveness
Coal power capacity will rise but impact will be regional

- Asia is focus for the world’s energy markets, especially in developing countries. Coal has a far greater market share than gas in the power sector.
- Exploitation of shale oil, with associated shale gas production, has transformed USA energy mix. Coal use has declined significantly. However, high cost shale oil production raises economic concerns sustainable, while methane leakage is an as yet unresolved climate issue.
- European Commission is driving forward a low CO₂ agenda, based on renewables and energy efficiency, plus gas as a back-up. This has cost and security of supply issues, plus gas leakage concerns.
Coal based aspirations towards lower carbon intensity

• High Efficiency Low Emissions (HELE) coal technology is available now and being deployed commercially, such as in Germany, India, Japan, Korea, USA and most especially in China.

• Development work is underway to establish advanced HELE systems that will provide a step change improvement to over 50% cycle efficiency for current systems.

• HELE can readily link with CCS when required.

• Major transformational technology development programmes are underway to further address limitations of existing systems.
High efficiency low emissions coal units are the norm in parts of Asia and are increasing in numbers elsewhere.

- **Isogo SC power plant near Tokyo**
- **Waigaoqiao No. 3 USC power plant in Shanghai**
- **Global USC coal power plants**
- **Mundra power plant, Gujarat**
Global USC coal power plants (JCOAL 2015)

- In 1993, Japan installed first USC unit and has continued with this technology for all new units.
- In 2006, first USC unit was put into operation in China. By 2017, its USC capacity will be over 208,000 MWe, with the 1000MWe unit now the technology of choice.
- USC are operated in more than ten countries in the world, with first units under construction in Malaysia (2015) and Taiwan (2016).
Means to implement HELE technology

- Tighten air quality standards
- Introduce emissions performance standards
- Introduce efficiency performance standards
- Ensure strong monitoring and verification
- Provide financial support for developing and industrialising countries to introduce such technology
New emission limits for coal power plants in the priority regions of China [GB13223-2011]

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Design standards for existing and new pulverised coal power plants in China

- Since 2006, new plants must be SC or USC of at least 600MWe capacity (excl. CHP and CFBC units)

- From 2015, for new coal power projects, unit capacity must still be at least 600MWe USC and mostly 1000MWe USC, but with net coal consumption lower than 285gce/kWh and 282gce/kWh respectively

- By 2020, average net coal consumption for all existing coal power plants must be lower than 310gce/kWh, with all such units of 600MWe and above having a specific net coal consumption of less than 300gce/kWh
Ever stricter control of pollutant emissions are being introduced

- For the eastern region of the country, the emissions from new coal power projects must meet the emission limits for a natural gas fired gas turbine plant of 10, 35 and 50 mg/Nm$^3$ for dust, $\text{SO}_2$ and NOx respectively

THIS IS ACHIEVABLE
IEA CCC study on potential HELE impacts in Asia

Projected increase in coal power capacity

Chart 1: Coal power in 10 Asian economies by region and technology (GWe)

Projected CO₂ emissions reductions from subcritical to USC

Chart 2: Annual reduction in CO₂ emissions from new coal power due to use of HELE in place of subcritical technology (MtCO₂)
The way forward

- Coal extraction and utilisation are set to continue to expand over the next 2 decades.
- Coal has an important role in a secure and sustainable energy future but it will ultimately need to be a low carbon future.
- Increasingly, the focus for coal use will be China, India and the rest of Asia.
- While China is taking very significant steps to improve efficiency and limit environmental impact, there is considerable scope to do better in many of the other Asian countries and elsewhere by creating conditions to enable the use of advanced, cleaner, more efficient technologies.
- Need to incentivise best practice, high efficiency and low emissions, rather than just focus on CCS.
- Knowledge transfer will remain important and the Clean Coal Centre can fulfil a key role in disseminating technical, policy and regulatory information on a global basis.
Two days of technical sessions covering:
• Flexible USC for renewables-rich grids
• AUSC materials and plant design
• Supercritical CO₂ cycles and the Allam Cycle
• Developments in IGCC
• Advanced sensors and pollutant controls

Including presentations from:

Concludes with a visit to Isogo – one of the world’s cleanest power plants.
Thank you for listening!

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