The Global Context for Low Emission Coal Technologies

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Outline of presentation

• A primer on the world energy outlook

• Global GHG emission reductions from energy use

• The role and status of low emission coal technologies
Global energy demand set to increase by more than half - China & India will contribute about 45% of the increase in global energy demand to 2030 on current trends.
55% increase in CO₂ - more than half of the projected increase in emissions are from coal-fired power plants in India and China.
Requires a portfolio of options to reduce CO$_2$ emissions

- Carbon Neutral Energy
  - H$_2$ Economy (?), De-carbonised electricity (?)
  - CO$_2$ capture & storage and low emission coal
- Conservation, efficiency and lower carbon fuels
- Nuclear fission & Fusion ?
- Renewables
- Fossil Fuels

In 2030 >53% increase; 82% fossil fuel, 12% renewables, 6% nuclear
Cutting energy emissions in support of climate stabilisation goals, 450 ppm CO$_2$e

Baseline Emissions 62 Gt

-50% of 2005 Emissions 14 Gt

G8’s 2009 aspiring goals for 2050;
-80% for developed nations
-50% for developing nations

IEA 2008 in support of the G8 plan of action
Global deployment of CCS in the power sector - 2050

Anticipated emission reduction of ~ 3.6 Gt/y of CO₂ from low emission coal or 5.6 Gt/y from all thermal power plants
Global transport sector emissions reduction to 2050

Anticipated additional emission reduction of ~ 3.9 Gt/y of CO₂ from the deployment of vehicles using electricity and hydrogen

Source: IEA ETP 2008
The low emission coal (with CO₂ capture & storage) pathway

Requires economy of scale & technology deployment to achieve low costs
The options for low emission coal plants with CCS

Centralised power and industrial plants

- Gasification
  - CO₂ capture
    - CO₂ to storage
    - Chemicals
      - Hydrogen
      - Liquid Fuels
    - Power Generation
      - Electricity

Distributed energy & products

- Chemical products
- Distributed heat & power
- Transport vehicles
Technology maturity – CO$_2$ capture in coal power plants for first of a kind (FOAK) applications

- **Power generation with post combustion capture**
  - SC/USC pulverised coal fired power plants are reliable and proven
  - Scale up of solvent capture units/integration with power cycle is unproven.

- **Power generation with pre-combustion capture**
  - IGCC for coal (1 GWe) is near commercial and proving reliability, better experience with 3 GWe of IGCC capacity on oil and petcoke.
  - Solvent capture units for CO$_2$ available at scale, integration and power block hydrogen utilisation issues

- **Power generation with oxy-fuel combustion**
  - No proven experience of operation of pulverised coal power plants in an oxyfuel combustion mode – the issue is “confidence building”
  - Large scale air separation units for O$_2$ production proven and reliable.
  - Some development issues with tail end CO$_2$ purification
  - CO$_2$ or hybrid turbines do not exist for oxy-fuel combined cycles
Power generation efficiency with capture today – “the efficiency curse”

![Bar chart showing efficiency with and without capture for different technologies and fuel sources.]

Source: IEA GHG studies
Efficiency decrease due to capture

Percentage points

- CO2 compression and purification
- O2 production and power cycle impacts
- Shift conversion and related impacts
- Power for CO2 separation
- Steam for CO2 separation

Source: IEA GHG studies
Increase in costs of low emission plants

Increase in costs due to capture, %

Source: IEA GHG studies
Expected technology deployment for IGCC with CCS

- **CO₂ Capture Technology**
- **IGCC Power Plants**
- **CO₂ Storage**

1\(^{st}\) and 2\(^{nd}\) Generation IGCC with CCS

Expected availability can increase with time and learning by doing.

Elements currently commercial in the petrochemicals sector

Not All Technologies at the Same Level of Maturity.
The energy revolution – annual power plant capacity additions needed 2010-2050
A de-carbonized energy economy?

With CO₂ capture & storage, this could be a bridge to a sustainable energy future?

Increased renewable energy use is critical for future energy needs