Efficient water gas shift (e-WaGS) Technology for CO_2 capture

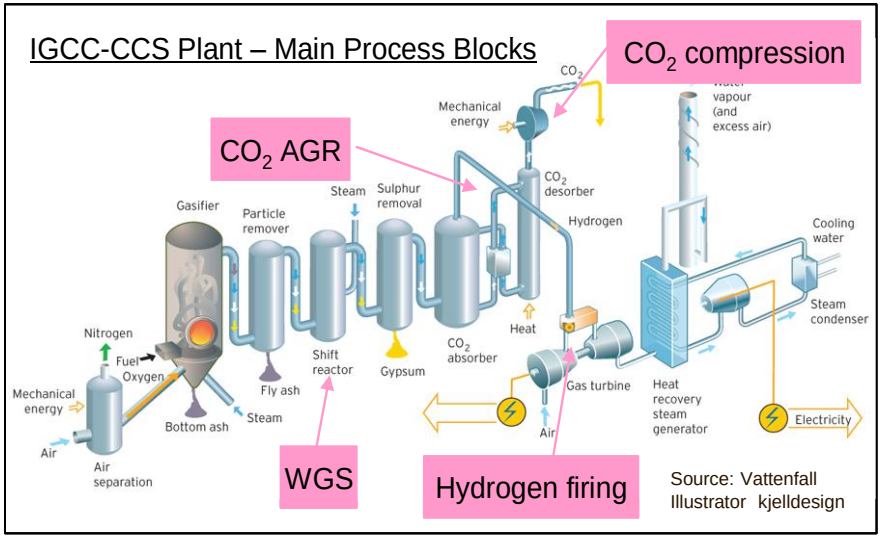
Jim Abbott,
Johnson Matthey, Billingham

13th Annual APGTF Workshop
20-21 Feb 2013, London
'Carbon Capture & Storage – a Showcase of UK Research and Development'

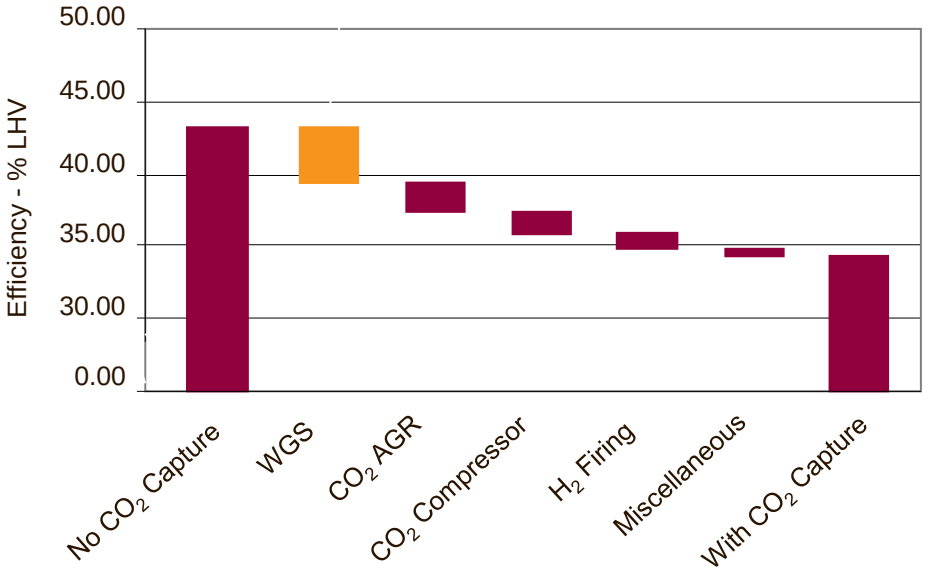
Johnson Matthey

e-WaGS - the opportunity

- IGCC with CCS
  - suitable for CO_2 capture
  - Process of choice for 2 bidders out of 4 in UK government CCS competition
- Sour Water Gas Shift
  - Key step in process
  - Biggest efficiency penalty
  - Large steam excess needed currently
  - Potential for significant improvement



WGS – accounts for 3.8% points (~8.5% eff.)
which is equivalent to 44% of the CO_2 capture efficiency penalty



Contribution of Sour Shift to energy efficiency penalty for IGCC with CCS (source – IEA GHG report PH4 -19)

Johnson Matthey

e-WaGS – the project

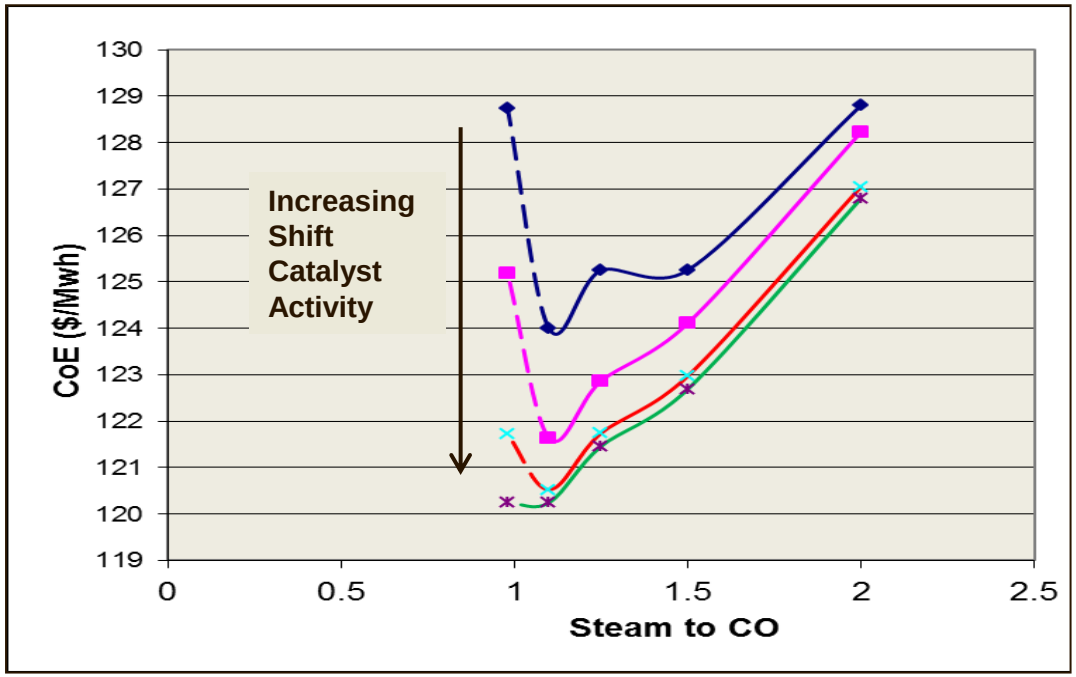
- Program scope
  - Target to develop efficient , low steam technology for IGCC with CCS
    - achieve Cost of Electricity (CoE) savings of >3%
  - Develop new Sour Water Gas Shift process & catalyst combination
    - Challenge is to improve rate & selectivity of shift reaction at low steam
    - Improved Catalyst and/or Reactor Technology required
  - Timeline 2010-2013
  - Target to be ready for demo at project conclusion
- Partners – Johnson Matthey and BP
  - Johnson Matthey Catalysts – global catalyst and process technology company
  - BP - major diversified energy company
- Partly funded by UK Technology Strategy Board (TSB)

Johnson Matthey

e-WaGS simulation results

based on process simulation and CAPEX estimation for Shell Gasifier case

- Lower steam leads to saving in Cost of Electricity (CoE)
  - ~ 4% at constant activity
  - up to 7% with improved activity catalyst
- Optimal steam to CO ratio unchanged at around 1.1
- Steam deficient operation not favoured



Benchmark process

- Conventional sour shift with Steam to CO ratio of 2.0 (Shell dry Gasifier with steam addition)
- Selexol™ for acid gas removal and CO_2 capture set at 85%

Johnson Matthey

e-WaGS highlights

- Projected cost of electricity reduction of 3.5-5.5%
  - £12-20 million per year for a 500MW facility with CCS
- Catalyst discovery and testing
  - Significant shift activity improvement in screening tests
  - Large reduction in methane formation in screening tests
  - 1 patent filed
  - Construction, commissioning, operation of pilot rig for ‘whole’ pellet testing
- New reactor and process integration
  - Gas cooled reactor for optimised reaction profile & low peak temperatures
  - 4 patents filed
- Synergistic integration with H_2 permeable membranes identified
  - >2% extra CoE reduction over [e-WaGS] + [membranes] added
  - Challenge is that membranes must be tolerant to up to ~1% sulphur

e-WaGS – next steps

- Ongoing testing on ‘whole’ pellets
  - Longer term operation at high & low temperature
  - Measure resistance to typical contaminant poisons
- Recycle of catalyst results into simulation / Capex
  - Update of benefit statement vs target
- Prepare design basis for demonstration of e-WaGS

Johnson Matthey

Acknowledgements

Johnson Matthey and BP gratefully acknowledge the UK Technology Strategy Board for their financial support in the e-WaGS Sour Shift Project

Johnson Matthey