



Update on Gasification Projects and Technology

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McIlvaine Hot Topic Hour
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“It was the best of times, it was the worst of times” – Charles Dickens



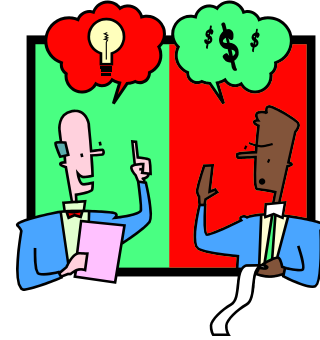
The Worst of Times

IGCCs face strong headwinds in Europe

- Vattenfall permanently closes its 250 MW IGCC located in Buggenum, The Netherlands
 - Cites decrease in power demand in EU and high fixed costs of the comparatively small coal power plant
- The Elcogas IGCC in Spain has seen a similar lack of demand for power
 - Did not operate for 5 months this year



Capital Cost Increases Hit US IGCCs



- Duke Energy's Edwardsport IGCC: \$3.5 billion or \$5663/kW "total project cost"
 - Estimated cost at beginning of project (Oct. 2006) was \$1.9 billion – actual was 184% of this estimate



- Mississippi Power's Kemper County IGCC has reached \$4.0 billion or \$7670/kW "total project cost"
 - Estimated cost at beginning of project (April 2010) was \$2.4 billion – current cost is 167% of that estimate

Mississippi Power's Kemper County IGCC Summer 2013



Photo courtesy of Southern Company

First-of-a-Kind Blues?



- Both the US Dept of Energy and EPRI have predicted costs for “nth-of-a-kind” IGCCs which are much lower than Edwardsport or Kemper
- DOE/NETL-2011/1498 report cites an IGCC with 60% CO₂ capture having a “total overnight cost” of \$3024/kW
 - This report is cited in EPA’s Greenhouse Gas New Source Performance Standard proposal – Sept 2013
- Adjusting Kemper’s costs to “total overnight” results in a current estimate of \$7190/kW – 238% higher than DOE’s

How do you get to the “nth” project when the 1st is so costly?

The Best of Times

Natural Gas is not cheap in most of the world

Natural Gas Overview: World LNG Prices

Federal Energy Regulatory Commission • Market Oversight • www.ferc.gov/oversight

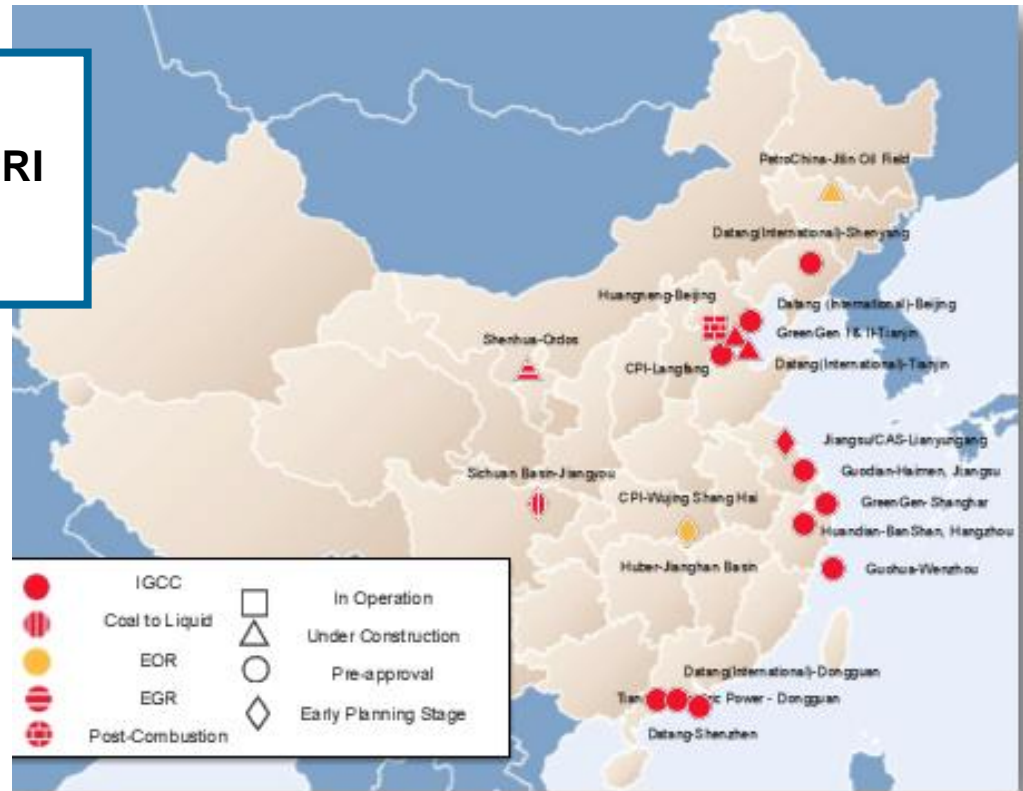
World LNG Estimated July 2013 Landed Prices



Asia IGCC Projects (1400 + MW)

• China

China - GreenGen - 250 MW – TPRI
 5 other IGCCs in planning
 300 more gasifiers by 2020



Source: World Resources Institute.

Korea

KOWEPCO IGCC - 300 MW – Shell/ GE Start up – 2015

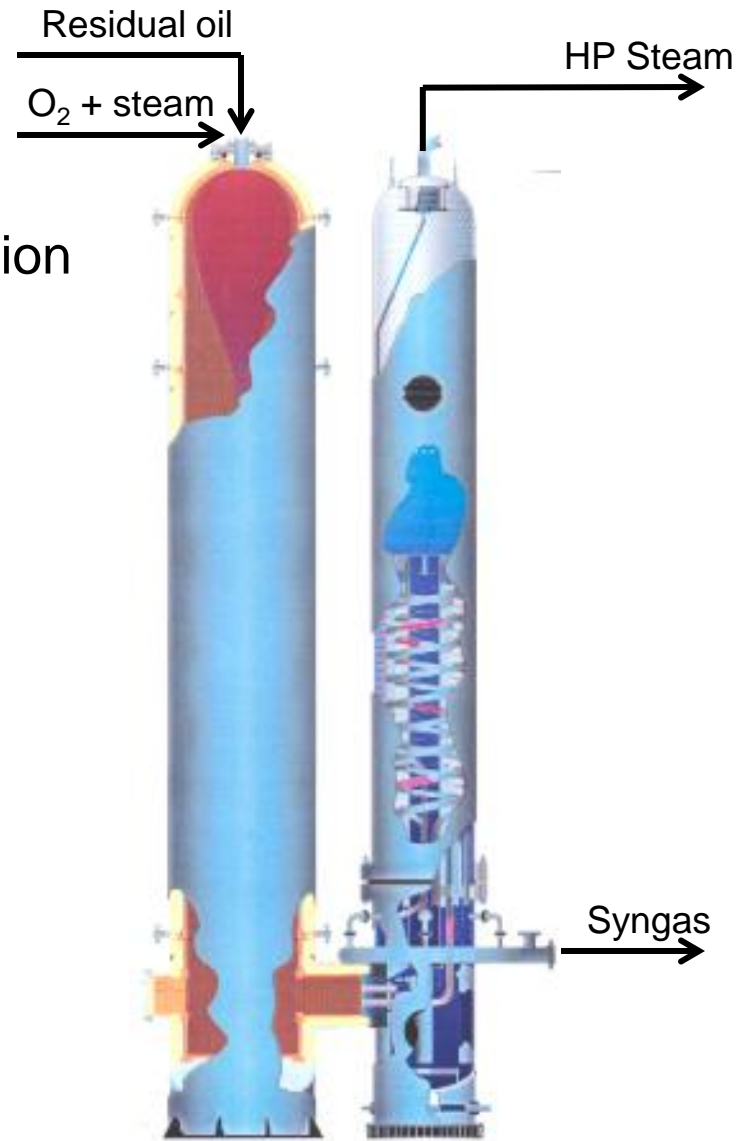
POSCO Coal to SNG – E-Gas™

Japan

Osaki CoolGen - 170 MW IGCC CCS Eagle Gasifiers, TEPCO&MHI - 2 x 500 MW

Saudi Aramco Jazan IGCC

- Saudi - Aramco Jazan
 - New 400,000 bpd refinery on Red Sea
 - 3,800 MW gross in multi block configuration
- Shell oil gasifier experience
 - 3 x 550 t/d in Shell Pernis refinery for H₂ plus 110 MW (2 x 6B GTs)
 - 3 x 1200 t/d in Fujian refinery for H₂ plus supply to 2 x 9E GTs
- GT award imminent
- ASU over the fence



Scale-up Plans for EAGLE Gasifier



EAGLE Project (J-POWER)

Coal Feed Rate : 150 t/d

Test Run : STEP-1 '02~'06, STEP-2 '07~'09, STEP-3 '10~'13

Objectives : Pilot test of Oxygen-blown Gasification
and Carbon Capture Technology



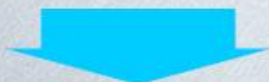
Osaki CoolGen Project (OCG)

Coal Feed Rate : 1,180 t/d (Output 166MW)

Location : OSAKI Power Station (Chugoku Electric Power Co.)

Test Start Day : March 2017

Objectives : Large scale IGCC test of Oxygen blown Gasification
and Carbon Capture Technology



Oxygen-blown IGCC/CCS commercial plant
(300 - 600MW class)



J-POWER Wakamatsu



Chugoku Electric Power Co.
Osaki Power Station

Conclusions

- The commercial application of gasification technology is booming in Asia
- At the same time it has lost its appeal in North America and Europe
- If demand for energy picks up in Europe, interest in gasification may return
- In North America, unless natural gas prices return to $> \$8-10/\text{MMBtu}$, demand will be limited to niche applications

Together...Shaping the Future of Electricity