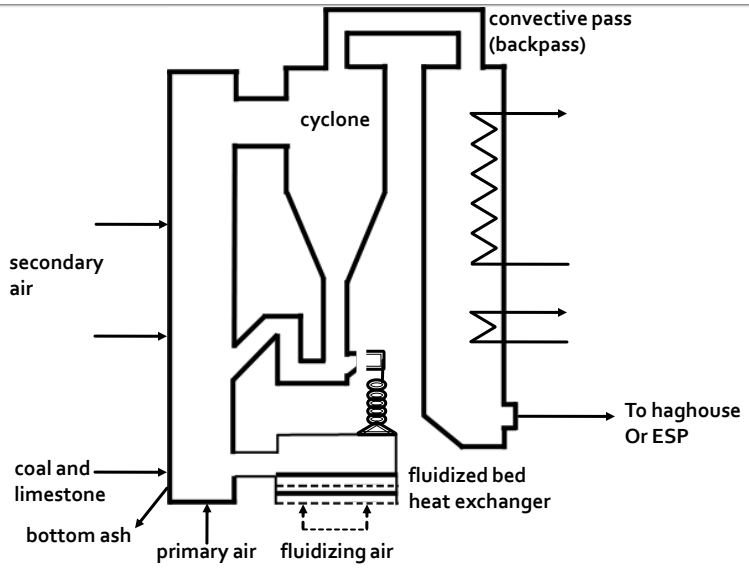
Plant Design

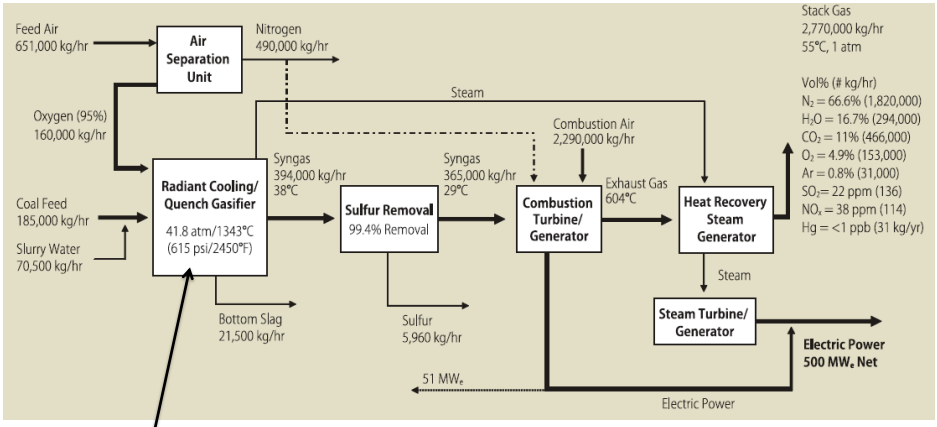
	Pressure	Temperature	Efficiency
Subcritical	<22.0 Mpa (16.5)	550C (540C)	33%-37% (34%)
Supercritical	>22.0 Mpa (24.3)	>550C (565C)	37%-40% (38%)
Ultra-Supercritical	Up to 32 Mpa	610C	43.30%

The Future of Coal, MIT, 2007

Fluidized Bed Combustion



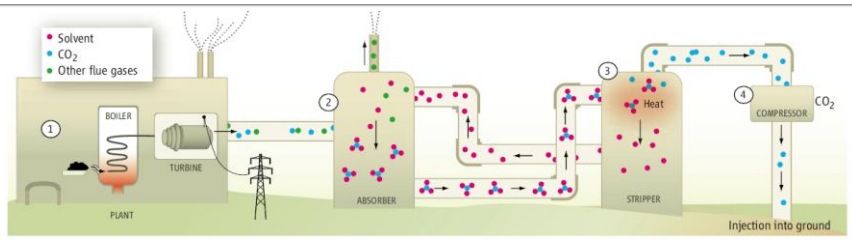
Gasification (IGCC)



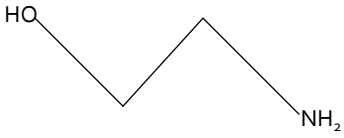
Coal + $H_2O \rightarrow H_2 + CO$

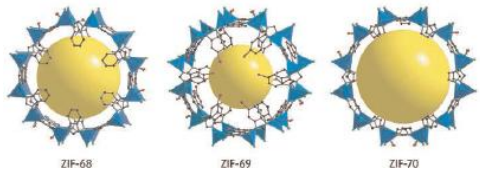
The Future of Coal, MIT, 2007

Post – Combustion CO_2 Capture



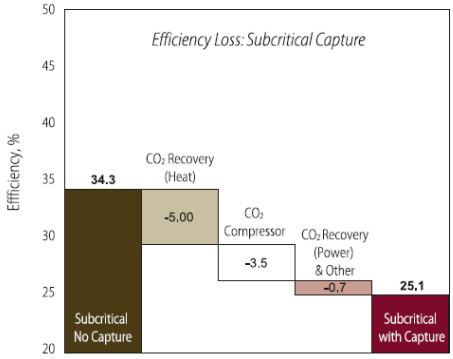
*Kintisch Science **317**:184-186*



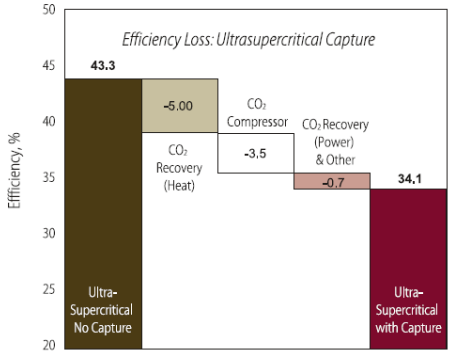


*Banerjee et al. Science **319**:939-943*

Energy Cost of CO_2 Capture



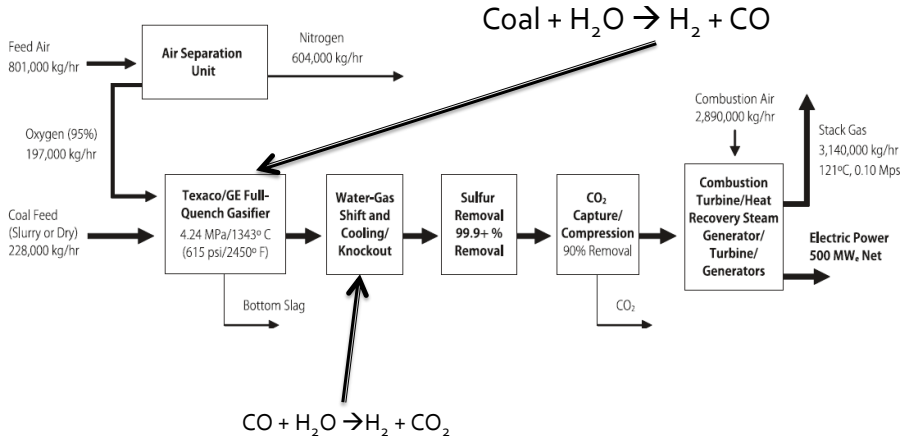
73 % of original efficiency



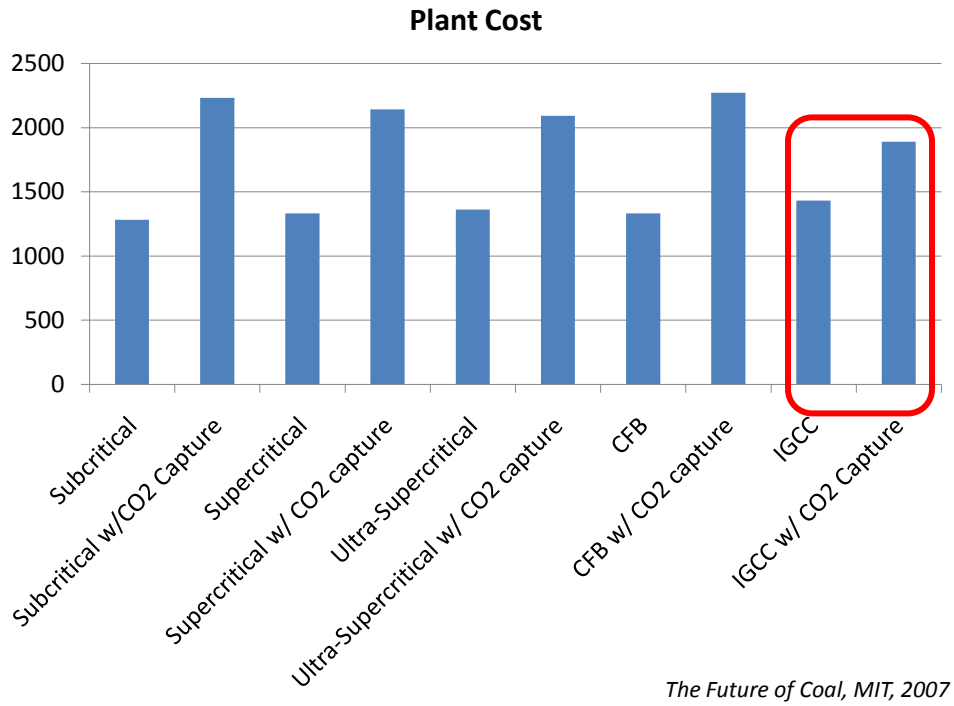
79% of original efficiency

The Future of Coal, MIT, 2007

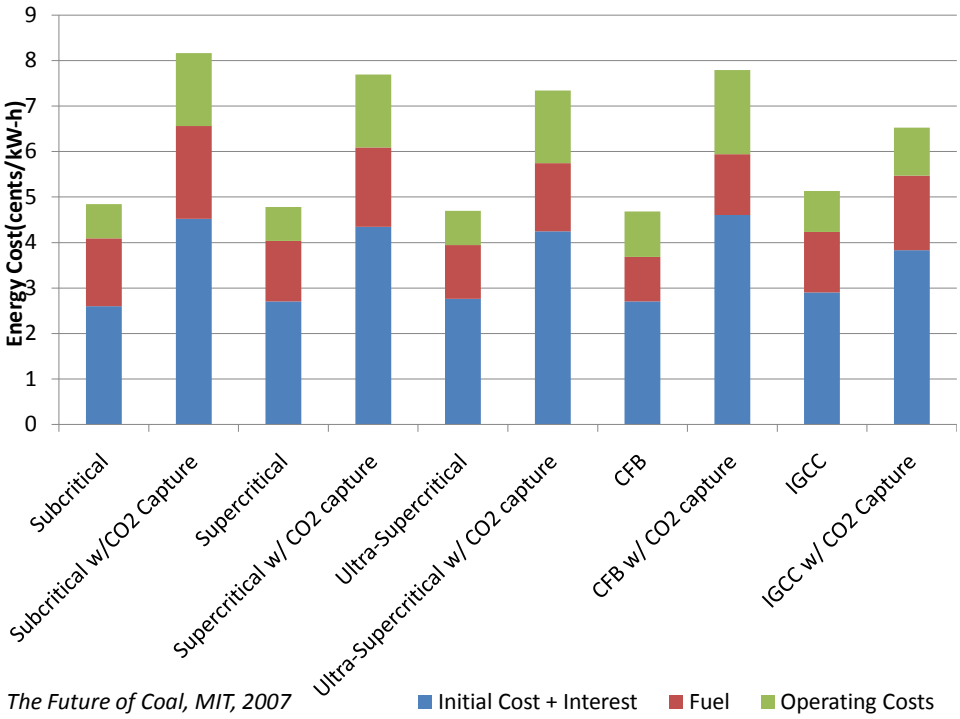
IGCC Pre-Combustion CO_2 Capture



The Future of Coal, MIT, 2007



The Future of Coal, MIT, 2007

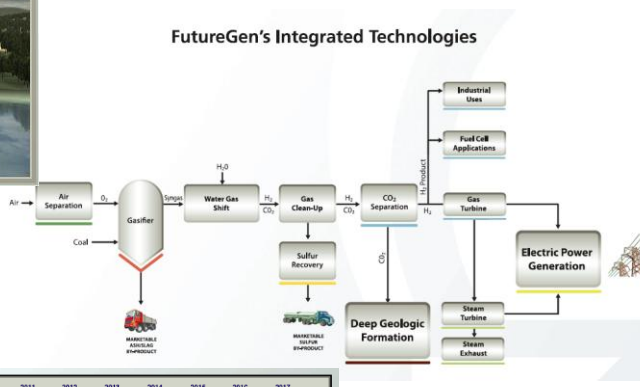


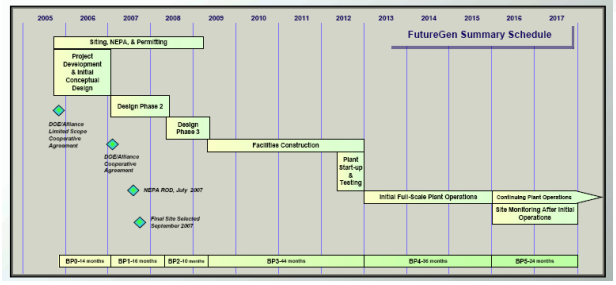
The Future of Coal, MIT, 2007

Carbon Cost at Which Capture Becomes Competitive

- Subcritical : $41.3/ton
- Supercritical: $40.4/ton
- Ultra-supercritical: $41.4/ton
- Fluidized bed combustion: $39.7/ton
- IGCC:$19.3/ton

The Future of Coal, MIT, 2007





NATURE|Vol 457|14 February 2008 NEWS

Natural gas back in favour with US power companies

Electric utilities in the United States are quietly shifting their sights from coal to natural gas as the lower-risk fuel while they wait for the nation's carbon policy to be decided.

Recent proposals to build coal-fired power plants have been sunk after hitting a wall of public and political opposition in Texas, Kansas, Florida, Investors and leaders — including of Wall Street's leading investment banks — increasingly worried about the impositio greenhouse-gas regulations in the coming y Add to this the rising prices of materials us steel and concrete, which are driving up c struction costs, and coal no longer looks lik safe investment it did just a few years ago.

This new calculus hit home in 2007, w plans for more than 50 coal-fired power pl were cancelled, according to consulting f Global Energy Decisions, based in Boul Colorado. In their place, experts say, util are turning to natural gas as a quicker, che and lower-emission alternative to meet gr ing demand while lawmakers sort out nation's carbon policy.

"Over the past year to two years the been this 180-degree turn from conce about dependence on natural gas to conc about climate change," says Larry Makov an energy analyst and senior power adv at Cambridge Energy Research Associ in Massachusetts. "The US power sector started to move back towards natural gas very substantial way?

Cleaner-burning natural gas became fuel of choice for new electricity generat in the 1990s, but increased demand coup with peaking production in many US gas fi caused prices to spike in 2002. At about U per million British thermal units, today's pr are more than triple the average throughout the 1990s. Building more natural gas plants could drive prices even higher — and make the nation that much more dependent on imports, which are already on the rise. Coal currently provides almost half of the nation's electricity and is one of the few domestic energy resources that remains in abunda Utilities also see coal, along with nuclear po and natural gas, as a critical source of cons 'base-load' power.

But given the major up-front costs and a lack of certainty about long-term economics owing to impending climate regulation, neither coal nor nuclear power look terribly attractive from an economic standpoint at the moment, says Revis James, a researcher at the Electric Power

Carbon burial buried

The US Department of Energy has pulled out of a flagship project to build the first 'clean' coal-fired power plant in the United States, a move that will kill the project unless supporters can rouse Congress on its behalf.

The FutureGen project was intended to demonstrate technologies for capturing and burying carbon dioxide from coal-fuelled power plants; it was doubled to $1.8 billion in recent years, and last week the department pulled out of the deal after failing to reach a new funding agreement with its private partner, the FutureGen Industrial Alliance, which consists of more than a dozen energy companies. The energy department had been slated to pick up three-quarters of the bill for the 275-megawatt plant.

"I'm disappointed because

Soaring costs mean the FutureGen power plant may never be built.

says Howard Herzog, a carbon-sequestration expert at the

"It's hard for me to see this not delaying overall progress."

In the project's place, the administration says it will help companies add carbon-capture and -sequestration equipment to new or existing coal plants that have at least 300 megawatts of capacity. Officials say this will ultimately save taxpayers money while allowing the technology to spread more quickly.

The abrupt decision has infuriated

nature Vol 449|6 September 2007

BUSINESS

King coal constrained

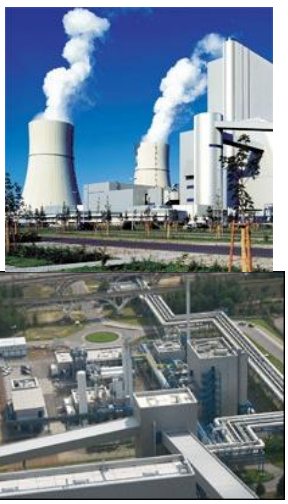
Sustained high oil prices won't be enough to make coal liquefaction economically viable without large-scale public investment. **Katharine Sanderson** reports.

Turning dirty coal into a clean-burning liquid fuel remains something of a challenge for the energy industry. As scientists heard last month at the annual meeting of the American Chemical Society in Boston, Massa-

Economic isolation forced South Africa to refine the coal technology used today at Secunda, Mpumalanga.

Spremberg, Germany

- First test plant for CCS
- 30 MW plant, cost $70m Euros
  - U.S. Average = 976 MW
- CO_2 separated, condensed, transported to gas field, forced 1,000 m underground
- Larger demonstration project slated for 2015



Conclusions

- World power demands are expected to rise 60% by 2030.
- Coal is a huge part of global energy use and is likely to remain important
- Technology exists to remove 90% of CO_2, 99% of sulfur dioxide, 99% of particulates, and 90% No_x
- Costs of implementing these technologies are large and possibly prohibitive