




Carbon Capture and Storage – Global outlook

Anna Skarbek – Presentation at Mansion House

15 September, 2008

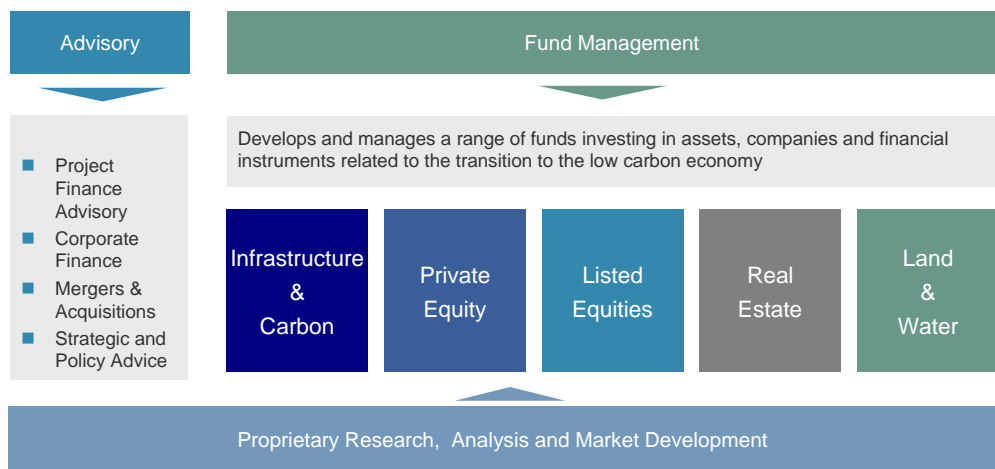
Climate Change **Capital** 

Introduction to Climate Change Capital

Climate Change Capital (“CCC”) is an investment manager and advisor specialising in the opportunities created by the transition towards the low carbon economy. Our activities aim to make the world’s environment cleaner while delivering attractive financial returns.

CCC is headquartered in London and has offices in Beijing, Boston, Madrid and Washington D.C. with over 150 employees focused on the EU, North America and China.

Through the combined talents of investment professionals, market specialists, thought leaders and access to a significant capital base, CCC is perfectly placed to deploy capital, at scale, to accelerate the transition to the low carbon economy. We call this creating wealth worth having.



CCS global outlook – Executive Summary

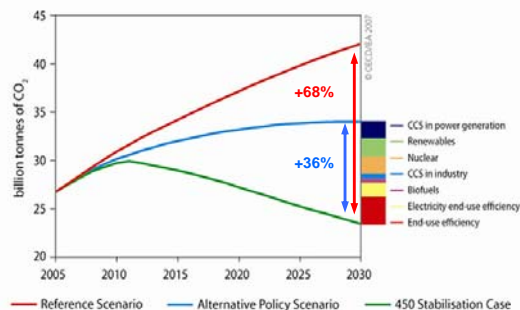
- Coal causes nearly half of all global CO₂ emissions
- Coal use is growing at an unprecedented rate
- Science-based CO₂ stabilization pathways require effectively zero carbon power generation from 2020
- CCS can play a major role
 - ▶ Work is progressing on proposed CCS plants in Europe and around the world
- But current policies are not sufficient to make CCS economically viable
- Will any of the various financial support proposals around the world deliver CCS deployment?
- Meanwhile new unabated coal-fired power stations are progressing at scale in Europe and around the world

Coal causes nearly half of all global CO₂ emissions ...

CO₂ emission evolution – scenario analysis

- In 2005 coal was responsible for 41% of total CO₂ emissions and 72% of all emissions from power generation
- Business as usual (reference scenario*) sees an increase of 15bn tonnes (Gt) of CO₂ between 2005-2030
 - Under the IEA's reference scenario by 2030 coal's share in global emissions is expected to grow to 45%
- The alternative scenario** plotted below estimates an increase of only 7bn tonnes of CO₂ between 2005-2030
 - This scenario sees coal's share in global emissions fall from 41% to 40% over the period
 - Emissions from coal would still grow in this scenario albeit at a reduced CAGR of 0.9%
- This would still be approx 9.5 bn tonnes above the 450 ppm stabilisation case

Global CO₂ concentration predictions



* The IEA reference scenario is the emissions path that the world will follow if nothing more is done by governments to change underlying energy trends, it takes into account **government policies and measures that had already been adopted** by mid-2007, regardless of their implementation status

** The IEAs alternative scenario considers current policies and measures that countries are **currently considering** and are assumed to adopt and implement, taking account of technological and cost factors, the political context and market barriers

Source: IEA World Energy Outlook 2007

Coal emissions: Key facts

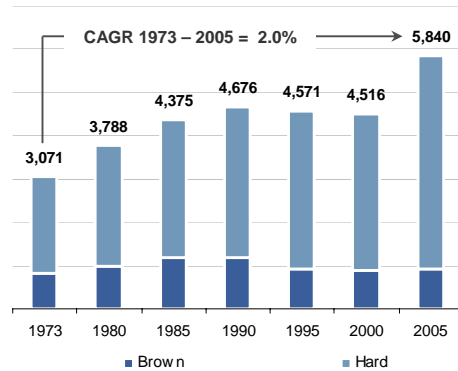
- Today coal is the largest single source of CO₂ emissions
- Under BAU assumptions coal will be responsible for 51% of the increase in global emissions – emitting 19 GT of CO₂ between 2005-2030
- Coal use changes could provide 15% - 55% of total global emissions reductions

... and coal use is growing at an unprecedented rate

Coal market facts

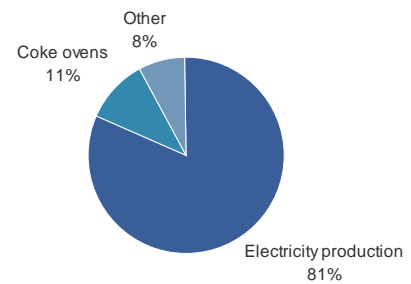
- World coal production has doubled since 1973 (an increase of 3,212 Gt; CAGR = 2.2%)
 - ▶ Hard coal is fuelling this growth – 96% of the increase over the period
- The demand for coal is high and accelerating
 - ▶ Coal production grew more in the first 6 years of this century than the previous 27 years (1,767Gt to 1,445Gt)
 - ▶ IEA predicts world primary energy demand to grow by 55% between 2005-2030, with coal having the biggest growth of 73% between 2005-2030 – increasing its share of global energy mix from 25% in 2005 to 28% in 2030
- Coal consumption is very concentrated – top five countries consume 74% of the global total
 - ▶ China alone makes up 41% of global consumption, 2.5x more than the US and 5.9x more than India

Global coal consumption (Gt)



Source: IEA World Energy Outlook 2007; IEA Coal Information 2007

Coal consumption by end use

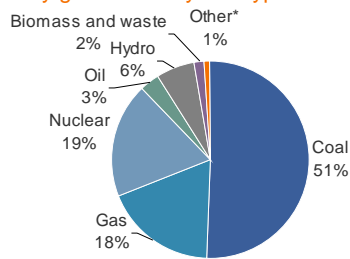


Coal is a dominant source of global electricity ...

Growth trends:

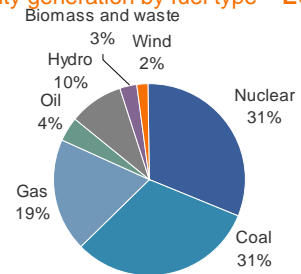
- Chinese electricity generation has more than tripled in size since 1990
- Annually China increases its coal fired power station capacity by the sum total of the UK's installed coal capacity

Electricity generation by fuel type – USA



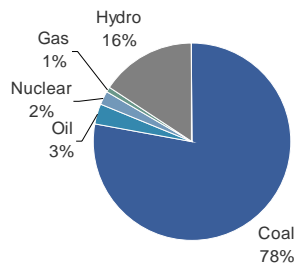
2005 Total electricity generated 4,266 (TWh)

Electricity generation by fuel type – EU



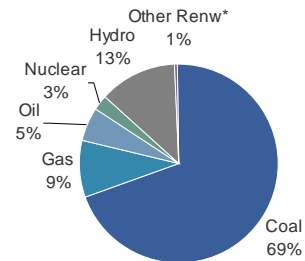
2005 Total electricity generated 3,276 (TWh)

Electricity generation by fuel type – China



2005 Total electricity generated 2,543 (TWh)

Electricity generation by fuel type – India



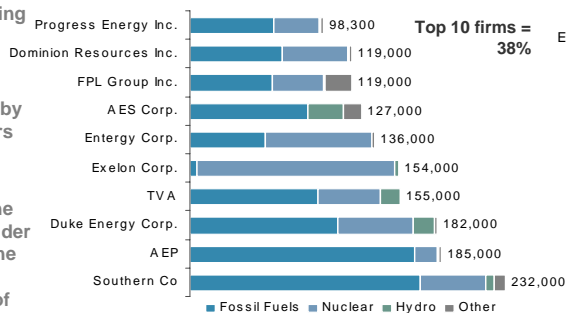
2005 Total electricity generated 698 (TWh)

... in relatively concentrated power markets

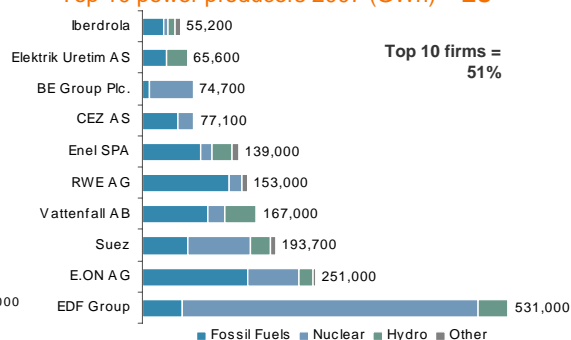
How will power market concentration affect the challenge of decarbonising the power sector?

- EU - over half of the power generation market is controlled by the 10 largest players
- US market is less concentrated than the other key regions under consideration with the lowest 10 firm concentration ratio of the group (38%), however the coal producing states wield considerable political power
- China's ten largest firms comprise 41%, including five large integrated power producers and retailers created from the split of the State Power Corp in 2002
- India's ten largest firms comprise 61%, mostly state controlled

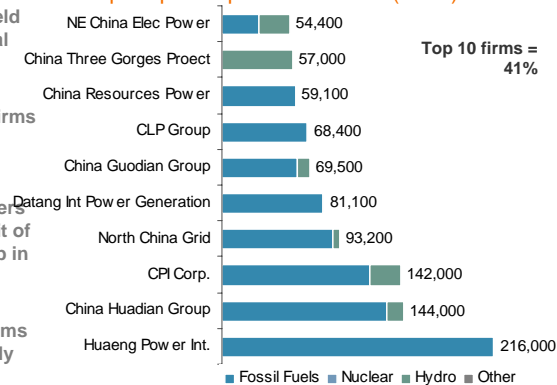
Top 10 power producers 2007 (GWh) – USA



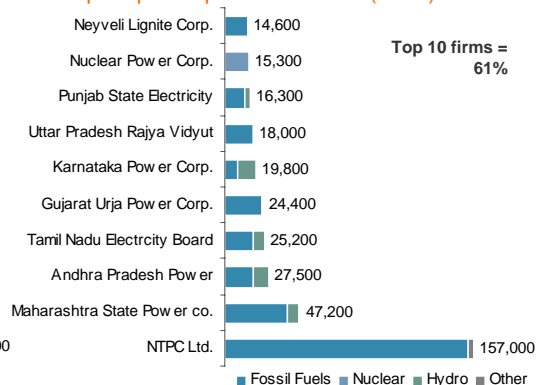
Top 10 power producers 2007 (GWh) – EU



Top 10 power producers 2007 (GWh) – China



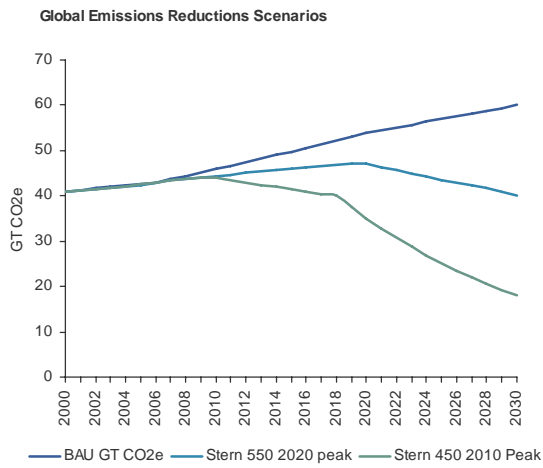
Top 10 power producers 2007 (GWh) – India



Source: CARMA (www.carma.org) – web-based database of power and emissions data produced and financed by the Centre for Global Development

Science-based CO₂ stabilization pathways require effectively zero carbon power generation from 2020

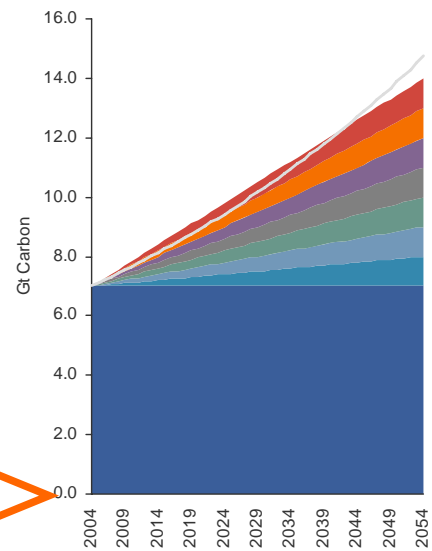
Stern's Stabilization Scenarios



If CCS is to meet one 'wedge' of the abatement required in the Princeton analysis, estimates require CCS to be installed on **800GW** of coal power plants

The Princeton Wedges

- Each wedge represents a 1Gt saving in emissions by 2054, sufficient reduction to stabilise global atmospheric CO₂ concentrations at 550ppm

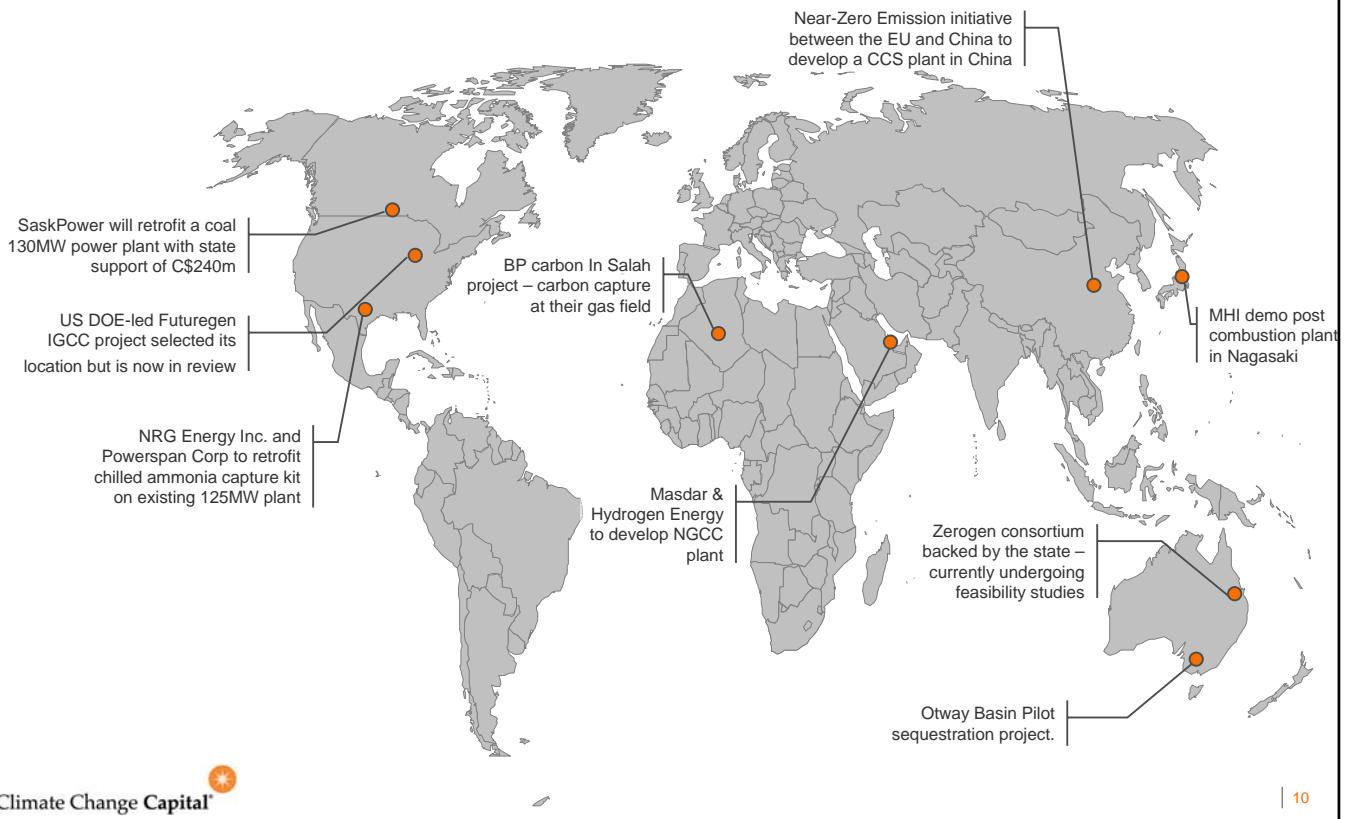


Source: "Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies", S. Pacala and R. Socolow, Science, August 13, 2004

Work is progressing on CCS plants in Europe ...



... and on proposed CCS plants around the world



But current policies are not sufficient to make CCS economically viable

Policy measures so far do not address the economic gap for CCS deployment

| Policy measure | Example | Issues |
|--------------------------------|--|---|
| Inclusion in the EU ETS | <ul style="list-style-type: none"> ■ EU ETS Phase 2 allows opt-in of plants that use CCS ■ EU ETS Phase 3 proposes to include plants that use CCS as installations <ul style="list-style-type: none"> ▶ But these installations will not be given any allowances | <ul style="list-style-type: none"> ■ By not giving any allowances to CCS installations, the only payment available for CCS is the avoided cost of permits. But when CCS plants compete with gas plants, the EU ETS price needs to be over €100 before the avoided cost makes CCS viable. |
| Inclusion in CDM | <ul style="list-style-type: none"> ■ CCS is currently not permitted in the Clean Development Mechanism (CDM) ■ Inclusion of CCS was debated at Bali, with little progress ■ A report in December 2008 will look at including CCS post 2012 | <ul style="list-style-type: none"> ■ No prospect of inclusion of CCS in the CDM before 2012 ■ Even if CCS was eligible for CERs under the CDM, the current price of CERs is not enough to make CCS viable ■ Demand for CERs will need a major increase to absorb CCS |
| Regulatory framework | <ul style="list-style-type: none"> ■ The EC CCS Directive in preparation for release in January 2008 will create a regulatory framework | <ul style="list-style-type: none"> ■ A regulatory framework is only a facilitating measure; it will not address the economic gap of CCS costs relative to market prices for power or avoided emissions. Therefore this is not sufficient without other policy or financial support |

Will any of the various financial support proposals around the world deliver CCS deployment?

1) Carbon finance – UN

- CDM methodology for cleaner fossil fuel power generation (eg supercritical coal)
- Discussions are progressing for allowing CCS to be included in CDM

2) Carbon finance – EU

- EU ETS supporters consider that the EUA price will offer incentive to reduce emissions in power generation
- EU ETS could act as a source of funding for the proposed EU Flagship Programme of 10 – 12 demonstration CCS plants

3) Carbon finance – US

- The emissions trading scheme proposed by the Warner-Lieberman Bill offered bonus allowances to CCS, but it failed to proceed to a Senate vote

4) Fiscal support – UK

- UK Government is offering funding via a competition for a 300 – 400MW demonstration CCS plant
- UK-China MOU on a demonstration CCS plant has offered a small level of initial funding

5) Fiscal support – EU

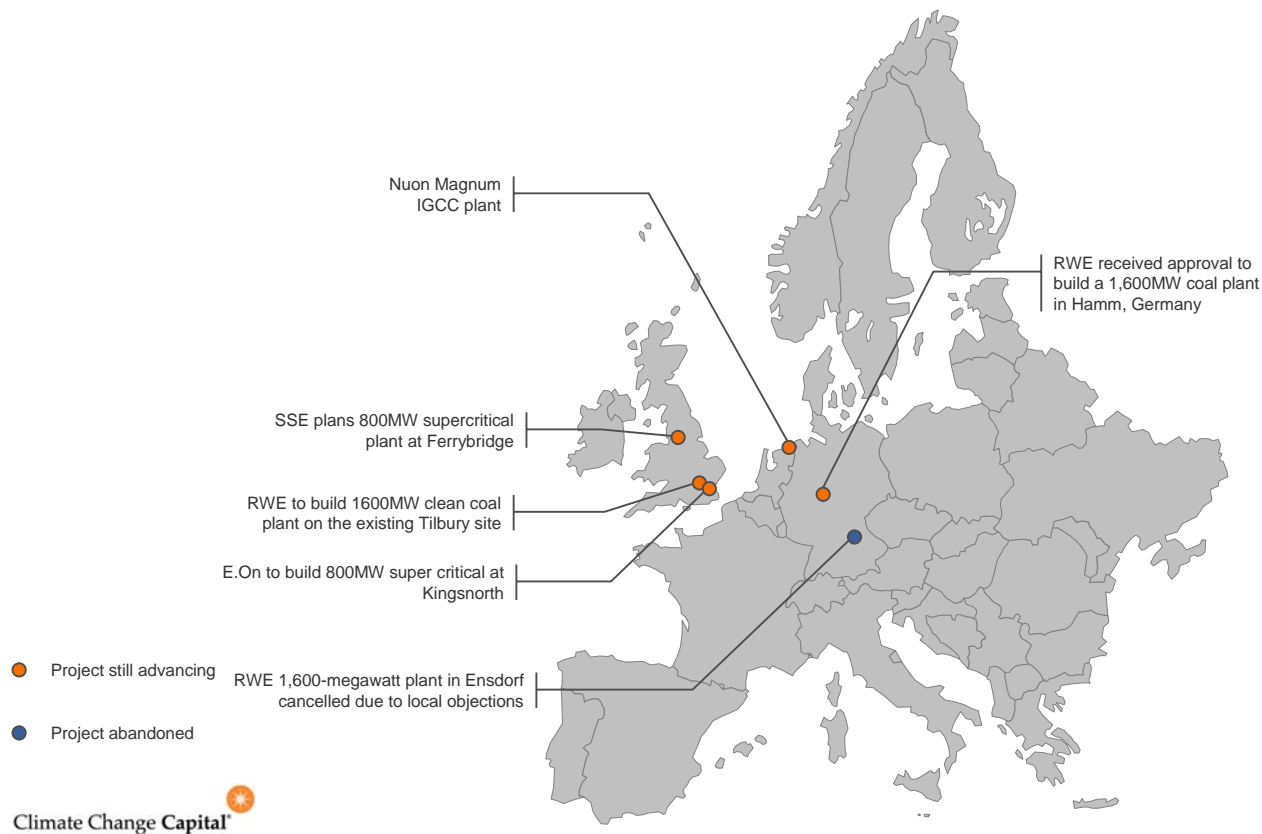
- State Aid clearance will be offered for supporting CCS
- Possible use of a special reserve of EUAs or auction revenues could support the EU Flagship Programme for 10 – 12 demonstration CCS plants

6) Fiscal support US

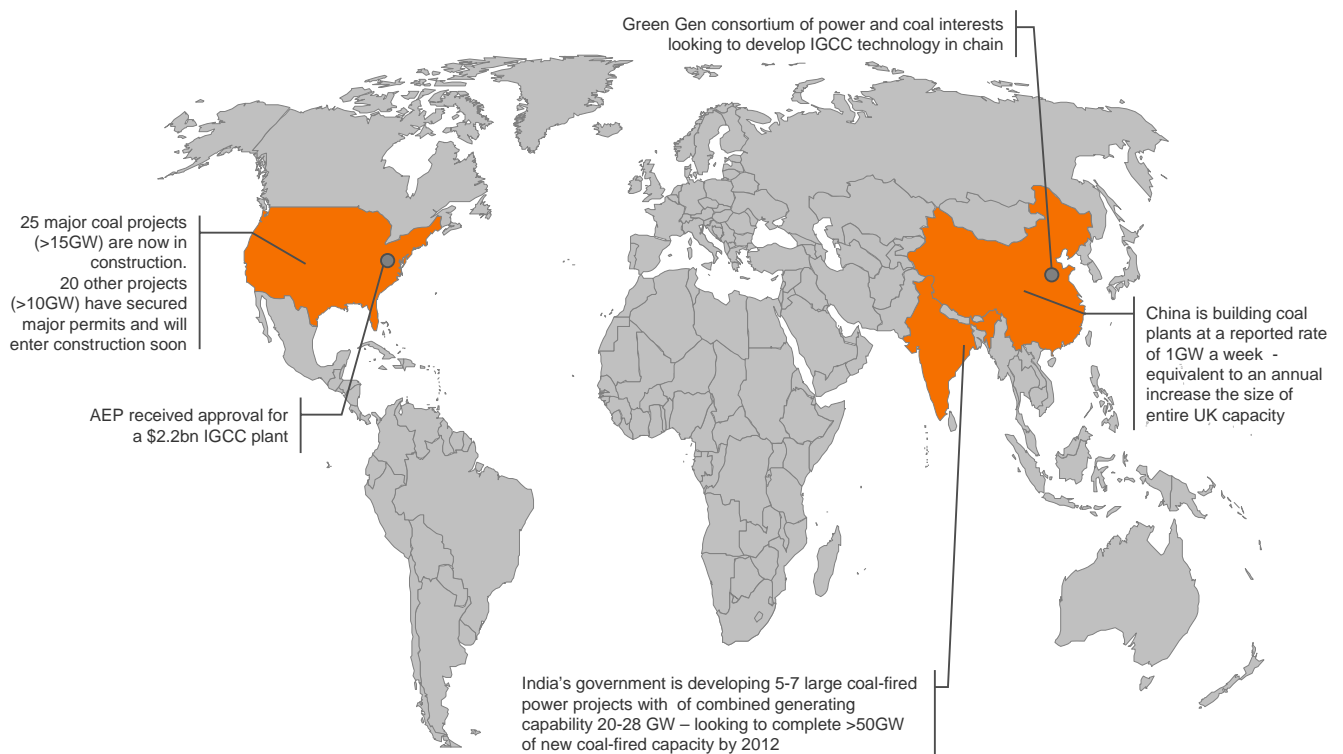
- President's Clean Coal Power Initiative provides \$2 billion of support over ten years, but so far no projects at commercial scale apart from FutureGen

But until a stable, long term measure exists that will cover the costs of CCS to the operators, we will not see the deployment at scale of CCS that we need . . .

Meanwhile new unabated coal-fired power stations are progressing at scale in Europe ...



...and even more new unabated coal-fired power stations are proposed worldwide



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