

Fossil Fuel power generation for the future



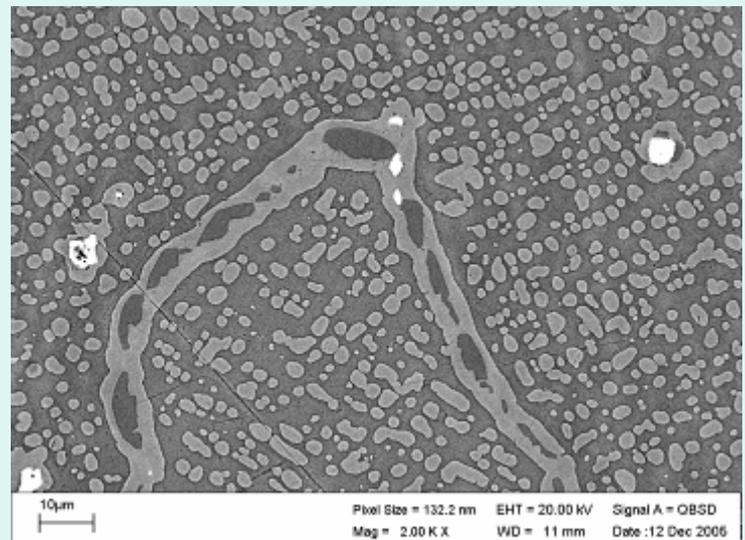
A presentation by Jonathan Wells for the MatUK Energy Materials
Dragons' Den event 22nd June 2008



- RWE npower operates and manages a flexible portfolio of coal, oil and gas-fired power stations.
- RWE npower manages a portfolio of cogeneration plant.
- In the UK, RWE is also at the forefront of producing energy through renewable sources.
- npower renewables, part of RWE Innogy, leads the UK wind power market and are leaders in hydroelectric generation.

Jonathan Wells

- Turbine Metallurgist for RWE npower.
- I am presenting fossil fuelled power on behalf of all the members of the Energy Materials Working Group.
- These views may not represent the views of RWE npower.



I care about Polar Bears!

- It is essential that we reduce our emissions.
- Renewable energy sources must be utilised as much as possible.
- However, we will still need to use fossil fuels, but we must use these as efficiently as possible.

Sustainable energy needs to be sustainable

- This includes economic viability!
- If the cost of power in UK becomes too great we could see a decrease in the competitiveness of UK Industry.
- “97% of businesses said they are currently more concerned with reducing costs than emissions”¹.
- In 2009 68% said the UK should take a leading role in reducing global emissions compared to 88% in 2008¹.
- Electricity price rises would also hit the general public.

1. From RWE npower's Business Energy Index Report

How much energy will come from fossil fuels in the future?

- In “Sustainable Energy – without the hot air”¹, David MacKay identifies that we typically use more energy than we can reasonably produce from renewables.

Need renewable energy sources the size of Wales!

- Could use less energy.
- Could fill the gap with Nuclear.
- Import the energy from Continental Europe.
- Could fill the gap with fossil fuels.

* “Sustainable Energy – without the hot air” David MacKay, Cambridge University, (downloaded from web November 2008).

How much energy will come from fossil fuels in the future?

Figure 2.7: Electricity generation mix in CAM, CEA, CCP and CCSP

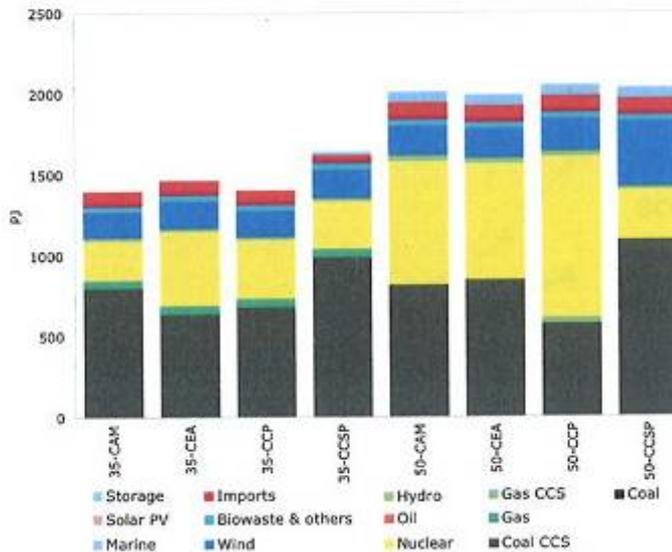
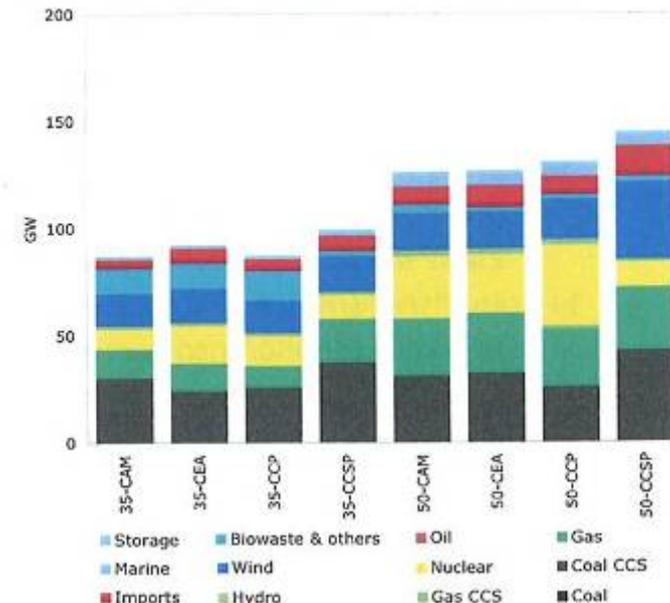


Figure 2.8: Installed capacity under CAM, CEA, CCP and CCSP scenarios

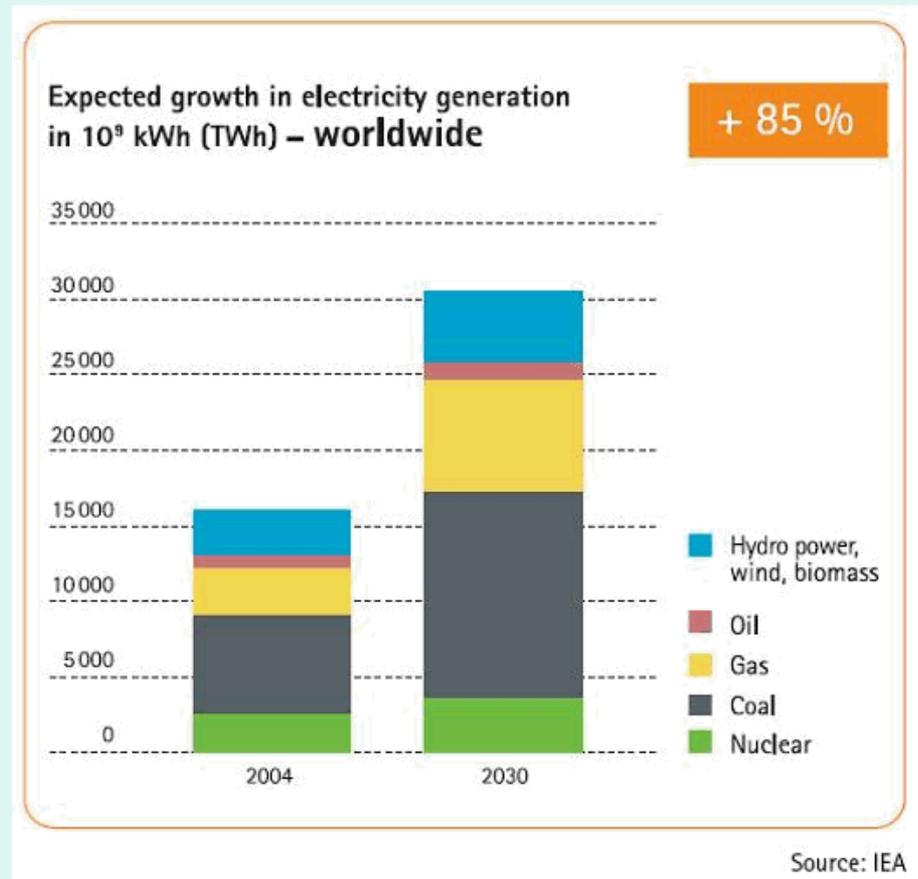


- In the future energy scenarios from the UKERC Energy 2050 Project Report² fossil fuels fill some of the gap.

Figures from “Making the transition to a secure and low-carbon energy system” UKERC Energy 2050 Project, April 2009.

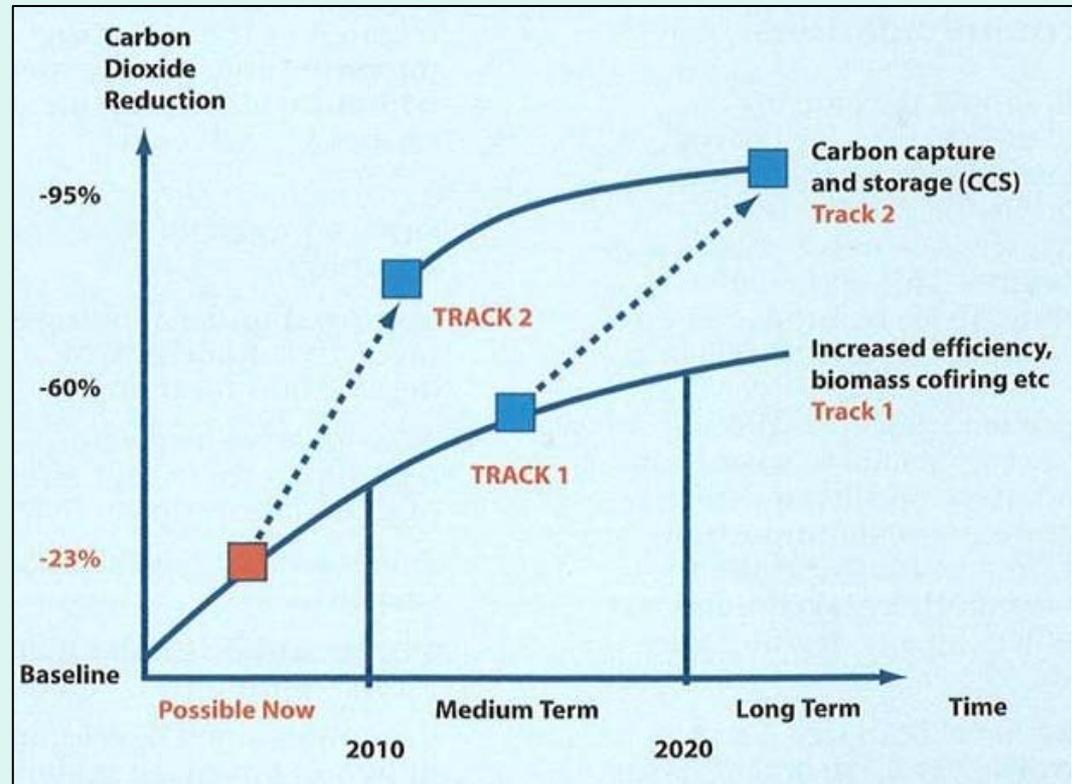
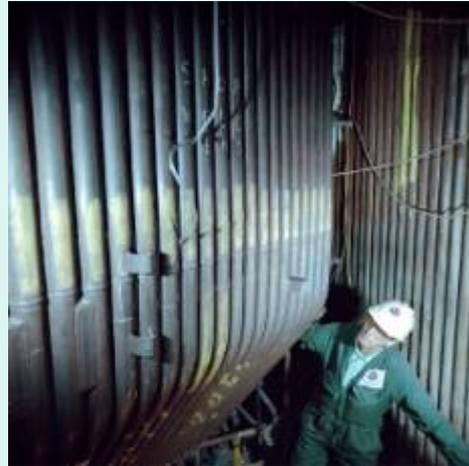
How much energy will come from fossil fuels in the future?

- Globally the demand for electricity is predicted to rise by 85% up to the year 2030.
- Fossil Fuels are predicted to contribute 70% of the global electricity generation in the year 2030.



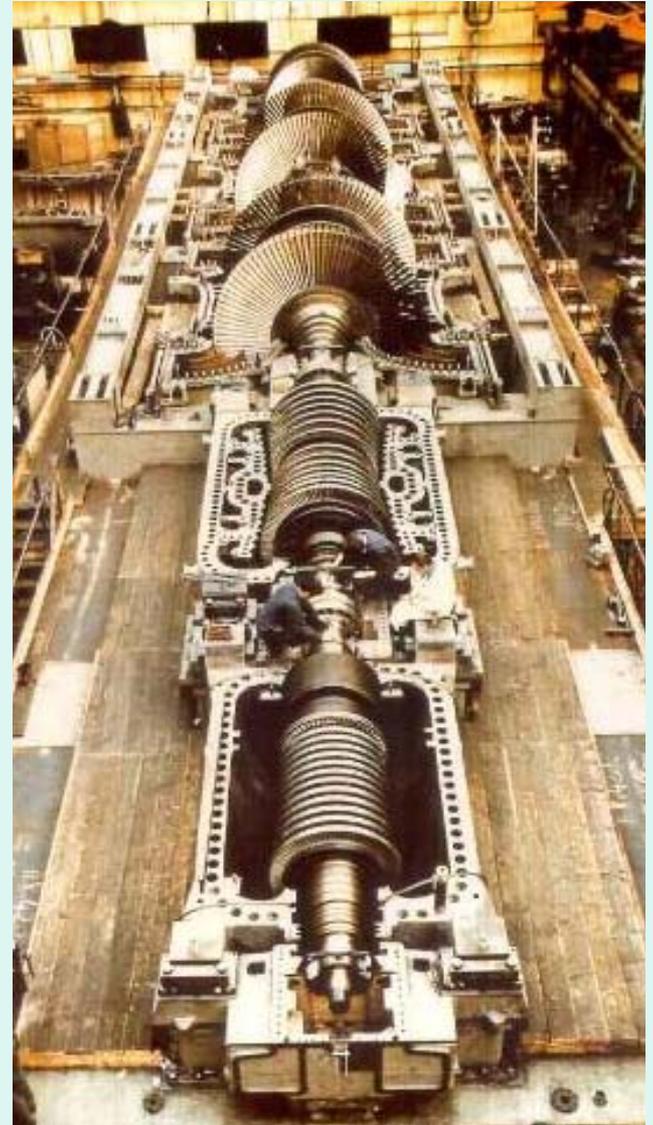
Reducing CO₂ emissions from fossil fuelled power plant

- Boilers.
- Steam Turbines.
- Gas Turbines.
- Gasifiers.
- CO₂ capture, transportation and storage.



High Temperature Materials

- Increased efficiency means higher temperatures and pressures.
- Fuel flexibility will lead to more aggressive environments (co-firing, biomass firing, oxy-firing, energy from waste)
- Need incremental changes to current materials.
- Need step change development of integrated materials system solutions for the future.



Carbon Capture and Storage

- Pre-combustion carbon removal – gasification.
- Post-combustion CCS – Amine scrubbing or some other process.
- Oxy-fuel firing giving a 100% CO₂ exhaust gas that can be pumped away.
- Need materials development to be able to scale the processes up cost effectively, and help develop new lower energy alternatives.

Amine Carbon Capture Pilot research facility at the University of Texas at Austin (RWE npower is an industrial sponsor)



Global Market for New Fossil Fuelled Power Plant

- Global market for new and replacement thermal power plants is currently about 140 GW p.a.¹.
- 310 GW of coal-fired and 170GW of gas-fired plant will be fitted with CCS by 2030 – 40GW p.a. between 2020 and 2030¹.
- Value to the UK is estimated at £1-2 bn/yr by 2020 and £2-4 bn/yr by 2030 – £20-40 bn in total between 2010 and 2030².
- 30,000-60,000 jobs in the UK in 2030.

1. IEA

2. DECC

Materials market potential in the UK from fossil fuelled power

Boiler Manufacturers

Doosan Babcock
Unit Superheater Engineering
TEI Green Overseas Ltd.

Steam Turbine Manufacturers

Alstom
Siemens

Gas Turbine Manufacturers

Rolls Royce plc
Siemens UK

End Users

RWE npower
E.ON UK
British Energy
Centrica
Scottish and Southern

Materials/Component Manufacturers

Cronite castings (castings)
Incamet Ltd. (castings)
Bradken Ltd. (forgings)
Somers Forge Ltd. (forgings)
Corus Engineering Steels
York Linings International Ltd. (refractories)
Sheffield Forgemasters (forgings)
William Cook Cast Products Ltd. (castings)
Firth Rixson (forgings)
Chromally UK (coatings)
Sermatech UK (coatings)
Deloro Stellite (welding and hard facing)
Sermatech UK (coatings)
Metal Improvement Company (shot peening)
TIMET UK Ltd. (titanium alloys)
Special Metals Wiggin Ltd. (nickel alloys)
Wyman-Gordon Ltd. (forgings)
Doncasters (castings and forgings)

The UK is strongly placed to take a lead on Research and Development

High quality is essential



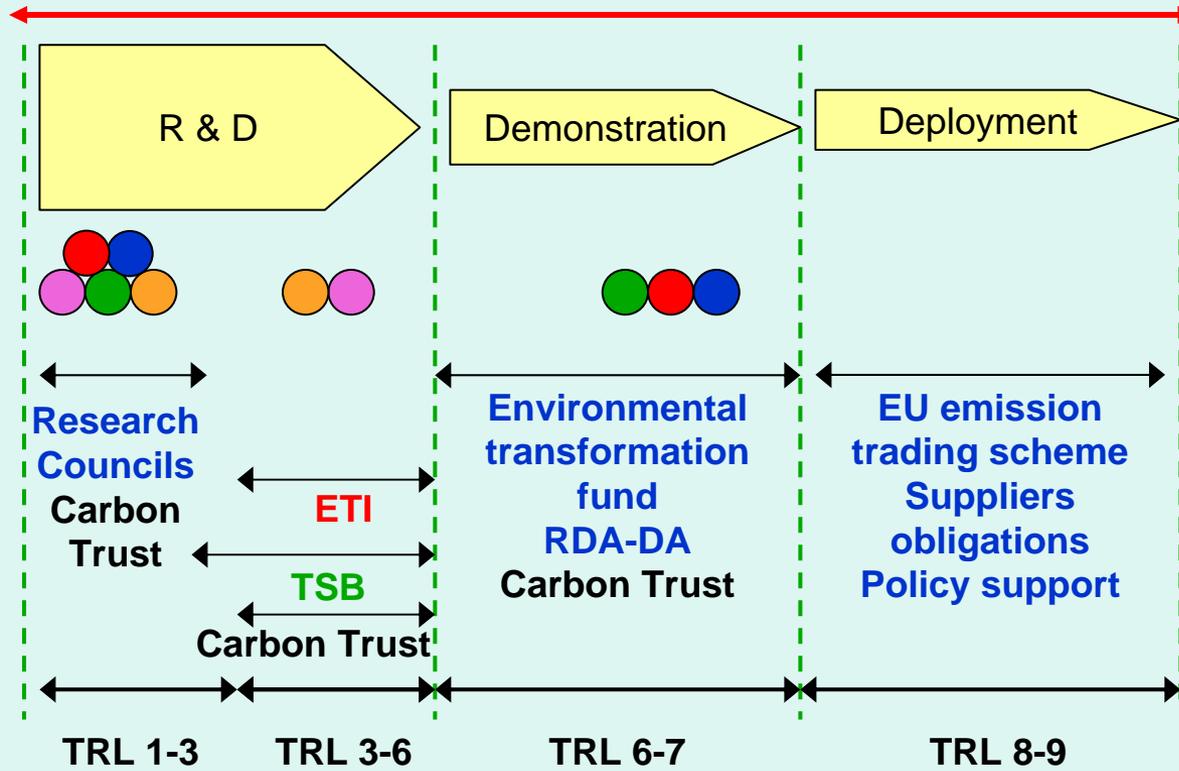
- There appears to be a gap in the market for high quality materials!

Technology readiness levels

Technology push and knowledge transfer ...

BERR Energy Unit, ERP, UKERC...

... market pull and public policy



- **Supercritical boilers**
- **Steam turbines**
- **Gas turbines**
- **Gasification**
- **CCS**

Concept taken from an ETI presentation.

Maintaining the grid

- It is popular to argue that the grid will be more unstable with increased renewables.
- The grid is designed to allow a major power station (~10% of capacity) to breakdown without the grid collapsing.
- OK – as long as power stations do not break down when the wind is not blowing!
- CCS may make fossil plant less reliable and less flexible.



Even if you disagree with everything I've said

- If the UK locally significantly reduces CO₂ emissions by decarbonising electricity generation it will not make a big difference on a global scale.
- Other countries are likely to continue to use Fossil Fuelled Power Stations.



Do we have a moral obligation to try and prevent this from happening?

Even if you disagree with everything I've said

Approximately
25% of personal
energy usage is
in 'stuff'
imported into
the country¹ -
how do we take
this into
account?



1. "Sustainable Energy – without the hot air" David MacKay, Cambridge University, (downloaded from web November 2008).

Any questions?



Aberthaw Power Station will be the first RWE npower site to use an Amine Scrubbing CCS pilot plant on an operational coal fired boiler.