

**APGTF Forum 2004
London
25/November/04**

Perspective on a CAT Strategy - Way Forward and Benefits

Nick Otter

Director of Technology and External Affairs, ALSTOM Power Ltd
and

Chairman of UK Advanced Power Generation Technology Forum

ALSTOM



• Energy Equipment/Systems Supply Company

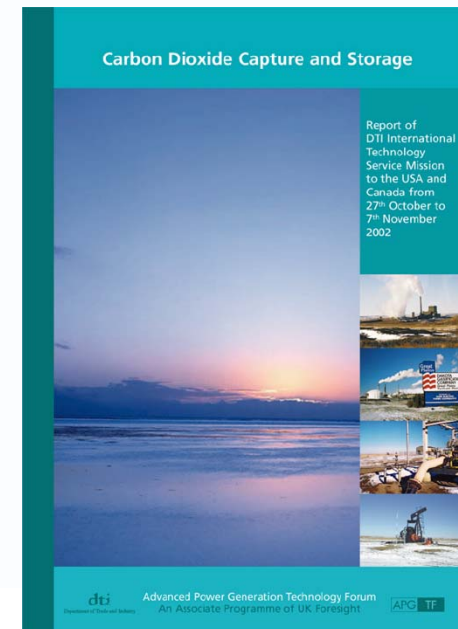
- ALSTOM Power : world-wide supplier of power generation plant, components and services

• Advanced Power Generation Sector

- UK Advanced Power Generation Technology Forum (APGTF)
- European Industry : EPPSA/ EUnitedTurbines

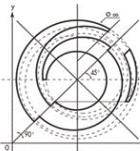
• EC Networks

- Thematic network on CO2NET, CAME-GT, POWERCLEAN
- Representative of European industry and researchers
- EU-25 wide





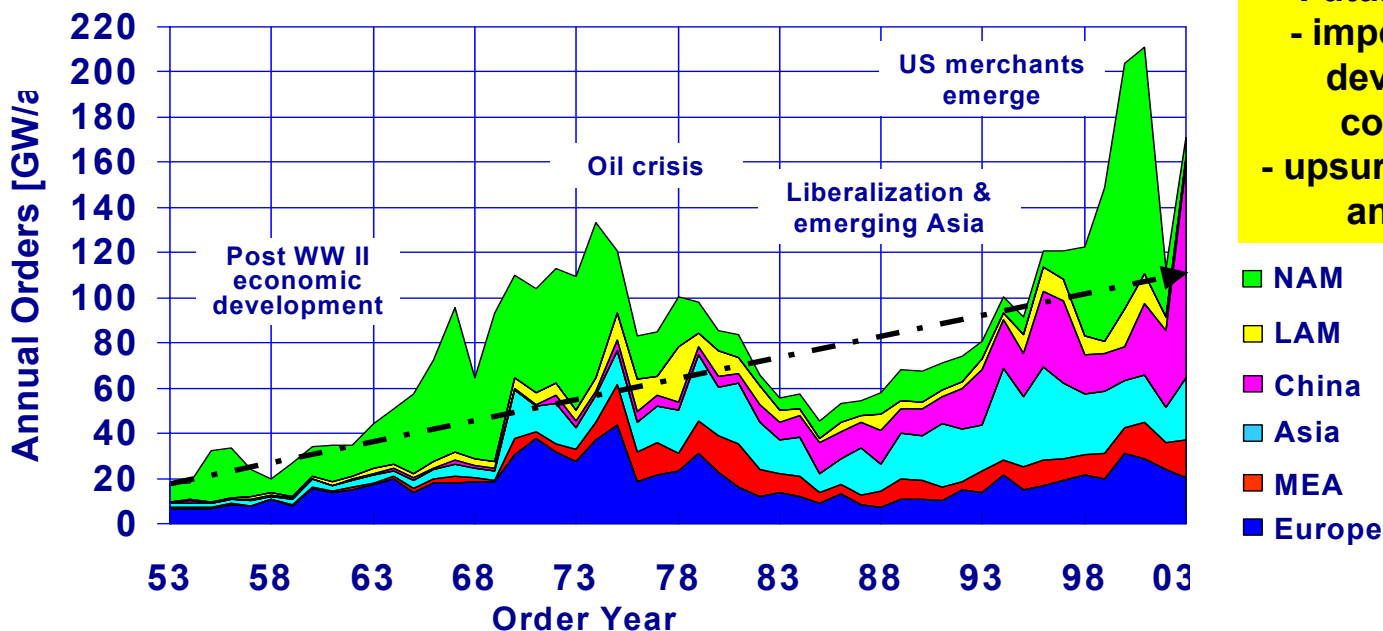
AN OVERALL PERSPECTIVE



50 Years Market Development Order Volumes by Regions



2 major growth cycles in the past led by NAM.



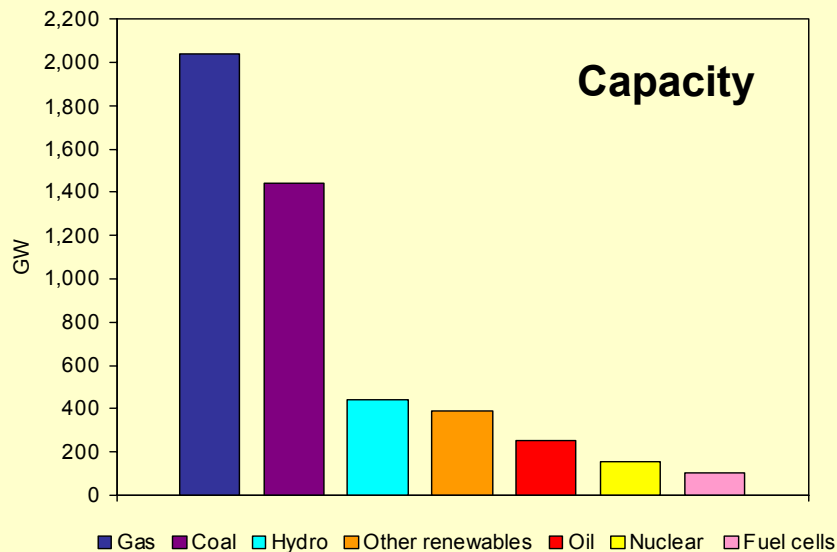
Future growth
- importance of developing countries
- upsurge in China and Asia

- NAM
- LAM
- China
- Asia
- MEA
- Europe

- GT & ST >= 3 MW , & Hydro >=10 & Diesel >= 1 MW
 - before 1974: data poor & excluding diesel. Hydro estimated from UDI
 - orders at risk of cancellation included

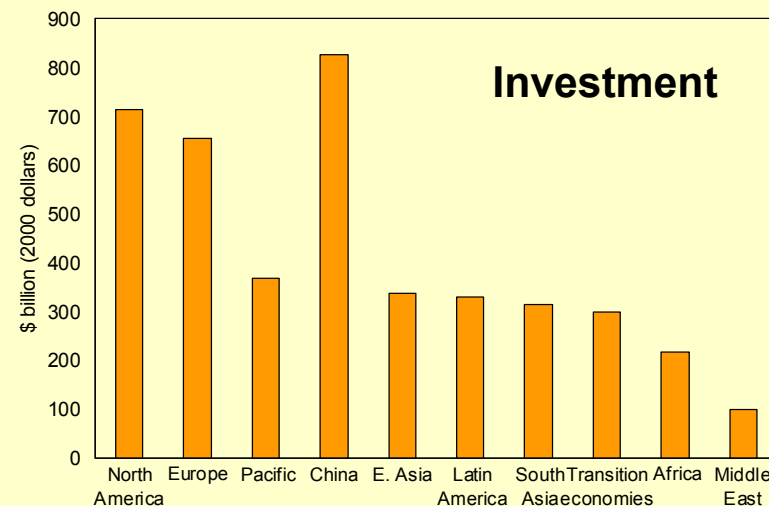
Sources: BD/MI, RDI Newgen May 2003

Significant impact of increased liberalisation, de-regulation and privatisation



IEA projections of global power station build to 2030

IEA World Energy Outlook 2003

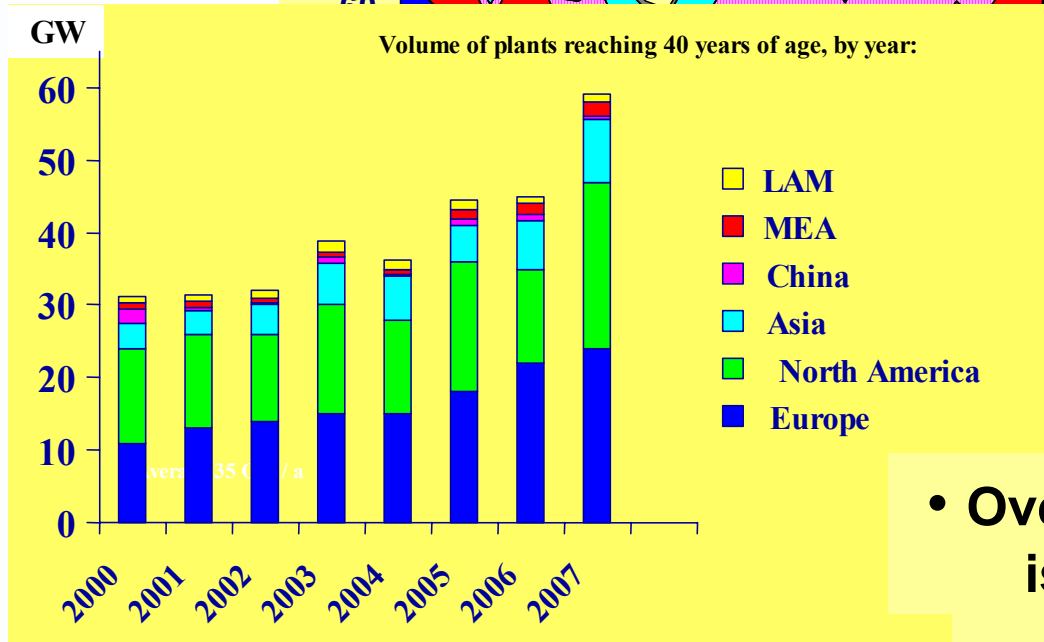
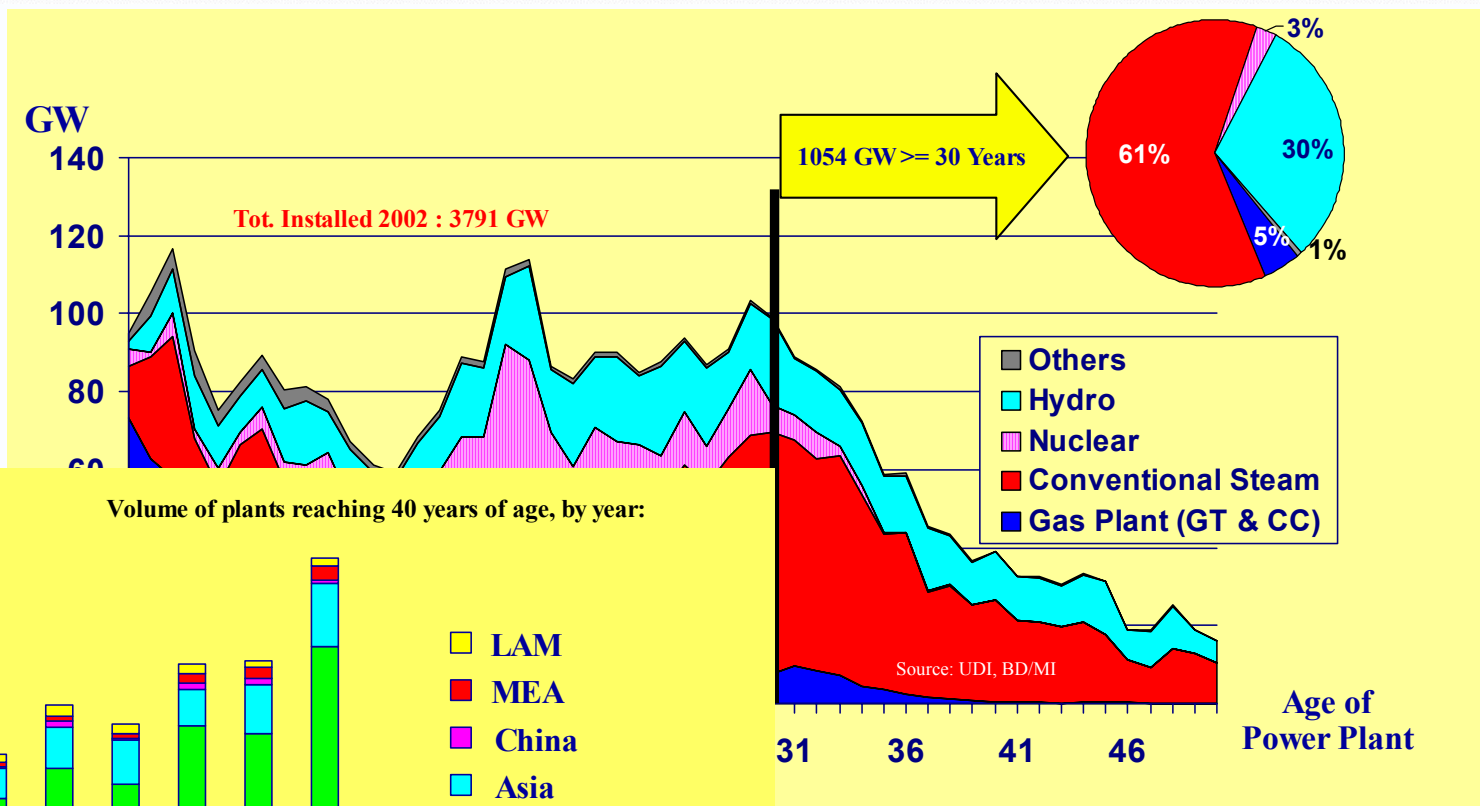


- **Different needs world-wide**
 - uneven access to modern energy
- **Growth of Renewable Energy but**

- **Continuing reliance on fossil fuels**
 - especially likes of China and India



Installed Base Capacity - Aging Fleet



• Over 1/4 of world-wide capacity is more than 30 years old
 a lot in the developed world



Power rationing threatens UK industry

BRITAIN'S biggest manufacturing companies are being told they need to accept power rationing or face blackouts this winter.

Last week, National Grid Transco (NGT), the monopoly gas and electricity distributor, approached its biggest customers and made clear they needed to consider cutting their use of power over the winter.

Companies that are big users of power, such as Rio Tinto and Alcan, have been approached by NGT to sign special "turn-down" contracts in which they agree to have their power cut by a specified amount after just a few hours' notice.

Firms are being offered lucrative deals to sign up to a power rationing programme in return for subsequent power cuts.

The agreement is that a blackout industry with de NGT has no keep its turned a household months.

An 2 "Instead generating the NGT chief es Britain' nies with tion of 1

Comp sign up deals a require power f process supply s

The Energy Intensive Users Group (EIUG), which represents Britain's biggest power users, estimates that 1,400 megawatts of power — equiva-

lent to that produced by two large power stations — could be made available to NGT under such agreements.

The contracts could be worth a total of £56,000 an hour to companies that sign up. NGT would have to pay enough to cover customers' lost production time. The amount would have to be at least equivalent to, if not more than, the cost to the customer of keeping its facilities powered up and running.

Companies can pay as much as £40 to use one megawatt of power for an hour during times

Lucinda Kemeny and Dominic O'Connell

of peak demand, compared with the average price of about £15, so NGT could face a very steep bill.

However, insiders said NGT had acquired a "sense of urgency" over the turnaround contracts as the winter months have drawn closer.

Years of overcapacity in electricity supply came to a dramatic end two years ago when the government introduced the New Electricity Trading Arrangements. For the first time, electricity generators had to trade power in a market sys-

tem and the price of the power soon fell by 40%.

TXU, the American-owned power company, collapsed last year and British Energy, the nuclear generator, almost followed because of the slump in prices. At the same time, many of Britain's power stations have

The result has been a rapid cut in overcapacity and growing fears that a cold winter could leave parts of the country in darkness. The looming crisis has already begun to take shape.

The result has been a rapid cut in overcapacity and growing fears that a cold winter could leave parts of the country in darkness. The looming crisis has already begun to take shape.

tem and the price of the power soon fell by 40%.

TXU, the American-owned power company, collapsed last year and British Energy, the nuclear generator, almost followed because of the slump in prices. At the same time, many of Britain's power stations have

The result has been a rapid cut in overcapacity and growing fears that a cold winter could leave parts of the country in darkness. The looming crisis has already begun to take shape.

The result has been a rapid cut in overcapacity and growing fears that a cold winter could leave parts of the country in darkness. The looming crisis has already begun to take shape.

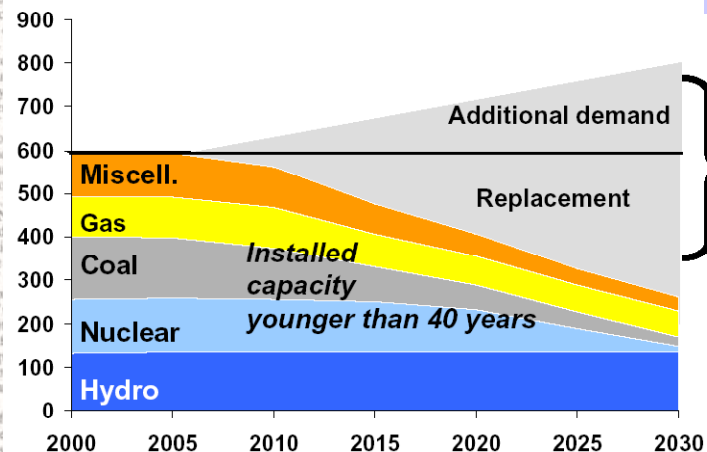
The result has been a rapid cut in overcapacity and growing fears that a cold winter could leave parts of the country in darkness. The looming crisis has already begun to take shape.



THE SUNDAY TIMES 24/August/03

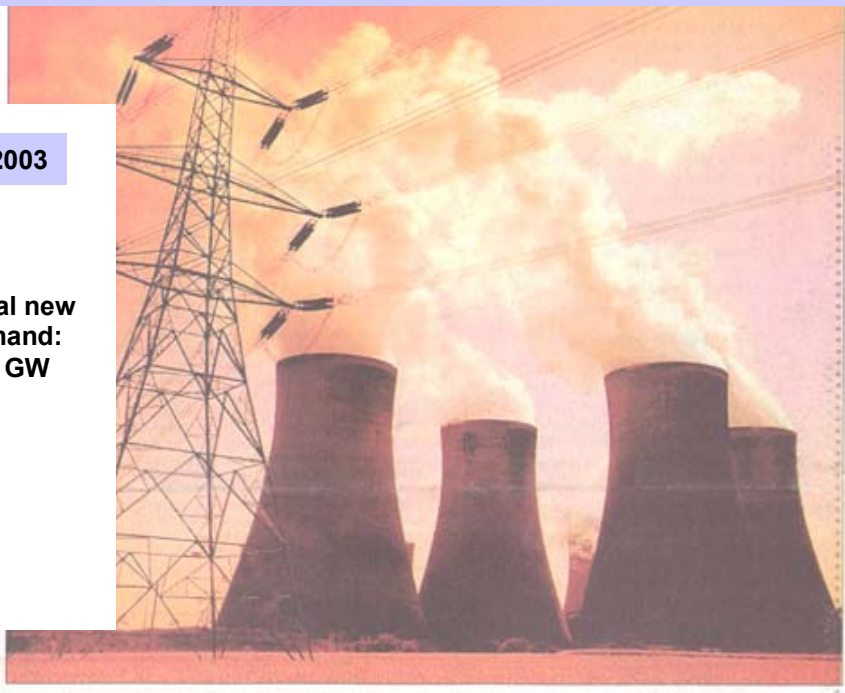
EC Green Paper on Security of Supply

Installed Capacity EU-15 GW



VGB 2003

Total new demand: 500 GW



Storms approaching: big firms are being urged to sign agreements to cut power use as the threat of winter blackouts looms

increasing concerns regarding supply



Environment

- Increasing recognition of Global Climate Change and impact of GHGs?
- Short term : Kyoto 2008-12, proving hard to meet? Boost from Russian approval ?
- Longer term : 60% reductions by 2050?
- How to engage of Emerging Market Economies?
- Impact of Emissions Trading?
- Emerging stricter regulation?

11 Oct 04

The Guardian

Climate fear as carbon levels soar

Scientists bewildered by sharp rise of CO₂ in atmosphere for second year running

Paul Brown
In a report published in the journal *Science*, the authors say that the world may have to face the possibility of a 1.5°C rise in the global average temperature by the year 2100. The authors also say that the world may have to face the possibility of a 1.5°C rise in the global average temperature by the year 2100.

Scientists are bewildered by the sharp rise of CO₂ in the atmosphere for the second year running. The rise in CO₂ levels is now being recorded at a rate of 1.4 parts per million (ppm) per year, which is a record for the past 100 years.

The rise in CO₂ levels is now being recorded at a rate of 1.4 parts per million (ppm) per year, which is a record for the past 100 years.

10 Oct 04

The Moscow Times

NO. 3018 OCTOBER 1-3, 2004 WEEKEND WWW.THEMOSCOWTIMES.COM

Conoco Buying More of Lukoil
Make starts to raise Conoco's stake to 10 percent. Page 5.

How to Write Like Tolstoy
Could there be a formula to the great Russian novel? Contact.

Car Plant GM, AvtoVAZ plan to move a factory from India, reports
Page 4.

Cabinet Gives Approval to Kyoto Protocol

By Greg Walters and Anthony Molyneux
The Cabinet on Tuesday gave approval to the Kyoto Protocol, the international treaty that aims to curb climate change by limiting greenhouse gases. The Environment Minister has been asked to sign the protocol on behalf of the UK.

The Cabinet on Tuesday gave approval to the Kyoto Protocol, the international treaty that aims to curb climate change by limiting greenhouse gases. The Environment Minister has been asked to sign the protocol on behalf of the UK.

Clean-coal technology could cut CO₂ bill by £3 billion

By Angus Thomson
The use of clean-coal technology could reduce the cost of electricity generated from coal by up to 10%, according to a report by the Energy Research Centre.

The use of clean-coal technology could reduce the cost of electricity generated from coal by up to 10%, according to a report by the Energy Research Centre.

A BRIGHT FUTURE FOR COAL

Coal is cheaper for removing greenhouse gases. A bar chart shows that for every tonne of CO₂ removed, coal costs £22, while gas costs £40 and nuclear costs £60.

...and we have lots of it. A map shows the distribution of coal reserves in the UK, with the highest concentrations in the north and west.

...and generate power. A bar chart shows that coal generates 40% of the UK's electricity, gas 33%, and nuclear 27%.

The Times 22 Nov 04

importance of environment as a driver



- All measures will be required
- No one single winning technology
 - complementary actions
- Broad portfolio approach necessary
 - energy efficiency, REN, fossil, nuclear
- Development of energy technology will be essential

→ Clean use of fossil fuels : a critical transition for decades yet in getting to a sustainable energy future



UK POSITION

APGTF Input to the debate

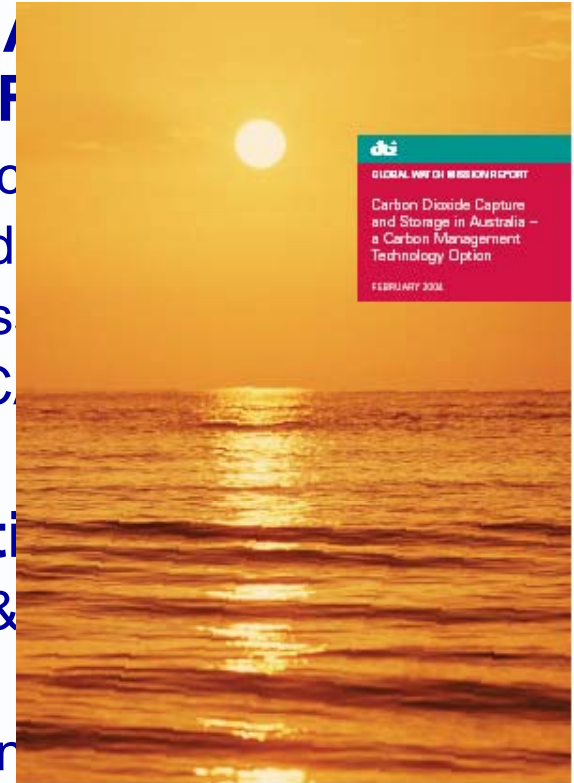


- **DTI working to establish a Carbon Abatement Technology (CAT) Programme for Fossil Fuels**
 - Power Generation but also Industrial Processes
 - Efficiency through to Carbon Capture and Storage
 - Link to Fuel Cell/Hydrogen/Sustainable Issues
 - established the Advisory Committee on CAT
- **DTI commissioned activity to position the UK**
 - Initiated a special bridging call of CCT R&D Programme
 - Review of CCT R&D Programmes
 - Feasibility of CO₂ Capture and Storage and EOR-CO₂ in UK
 - Supported Missions to US/Canada/Australia
 - Recommendations from Advanced Power Generation Technology Forum [APGTF]

Aim to produce a Carbon Abatement Strategy by end of 2004



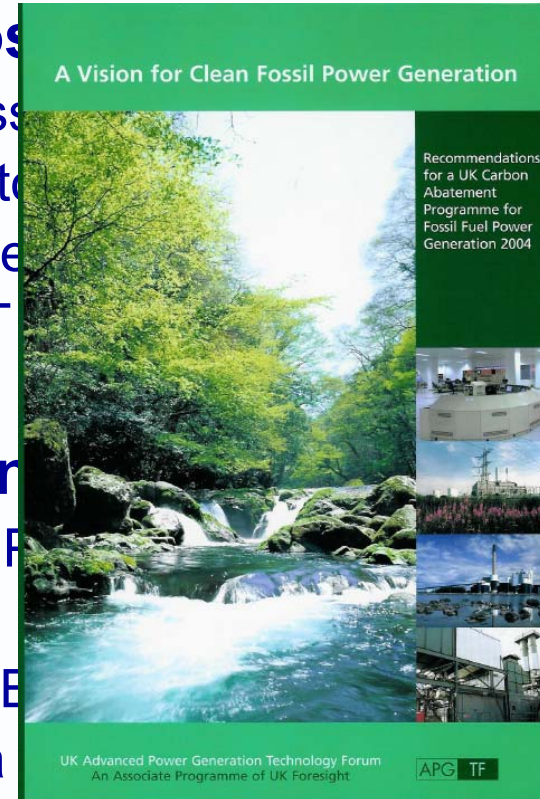
- **DTI working to establish a Carbon Abatement Technology (CAT) Programme for February 2004**
 - Power Generation but also Industrial Process
 - Efficiency through to Carbon Capture and Storage
 - Link to Fuel Cell/Hydrogen/Sustainable Isotopes
 - established the Advisory Committee on Carbon Abatement Technology
- **DTI commissioned activity to position UK as a world leader in Carbon Capture Technology**
 - Initiated a special bridging call of CCT R&D
 - Review of CCT R&D Programmes
 - Feasibility of CO₂ Capture and Storage and
 - **Supported Missions to US/Canada/Australia**
 - Recommendations from Advanced Power generation Technology Forum [APGTF]



Aim to produce a Carbon Abatement Strategy by end of 2004



- **DTI working to establish a Carbon Abatement Technology (CAT) Programme for Fossil Fuel Power Generation**
 - Power Generation but also Industrial Processes
 - Efficiency through to Carbon Capture and Storage
 - Link to Fuel Cell/Hydrogen/Sustainable Issues
 - established the Advisory Committee on CAT
- **DTI commissioned activity to position UK Power Generation**
 - Initiated a special bridging call of CCT R&D Programme
 - Review of CCT R&D Programmes
 - Feasibility of CO₂ Capture and Storage and Emission Reduction
 - Supported Missions to US/Canada/Australia
 - **Recommendations from Advanced Power Generation Technology Forum [APGTF]**





- Provision of affordable, acceptable and available low emissions power plant
- Provide UK industry with global market opportunities out to 2030
- Contribute to UK wealth creation/quality of life
- Help achieve CO₂ goals while providing security of supply : on the way to 60% reduction by 2050

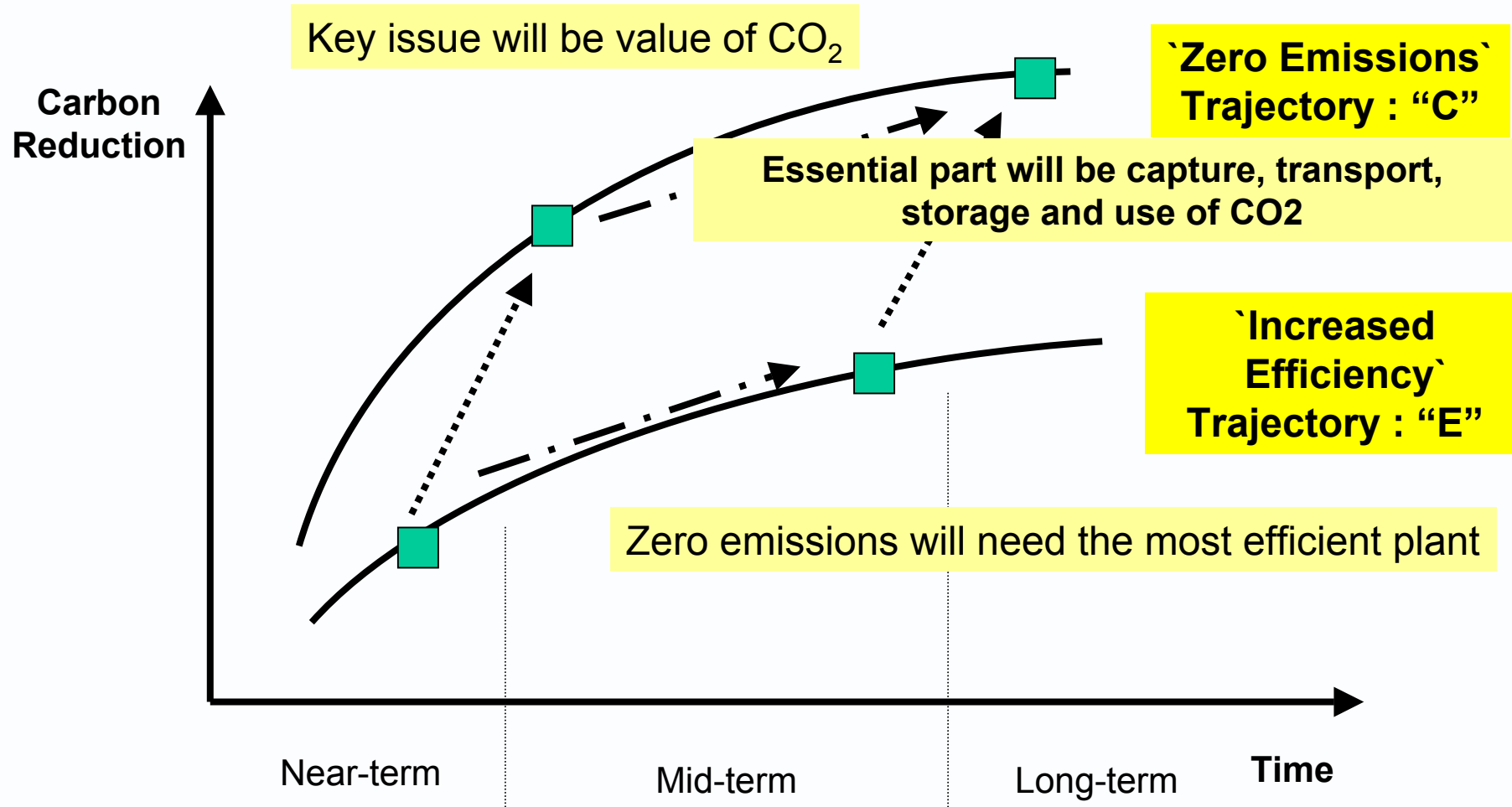
Power Plant Types : Pf + fgd/IGCC/GTs/Fuel Cells

CO₂ Capture : Post combustion/Pre-combustion/Oxyfueling

Fuels : Coal, Gas and Biomass



Strategic Trajectories



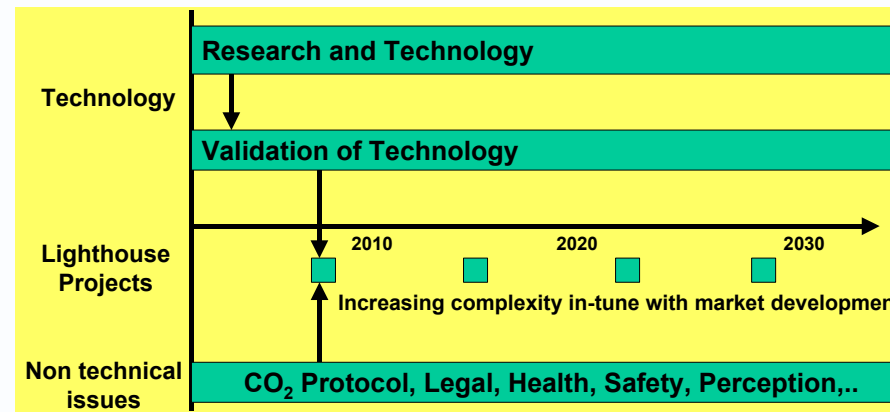


Carbon Management Strategy for Fossil Fuels



- Must be developed with the following in mind
 - Long term time frame : out to 2030 and beyond
 - Technology needs to be `in-tune` with market to engage investors
 - Recognition of need for early industrial benefits
- Must contain the overall approach of
 - Increased efficiency, fuel flexibility and re-powering
 - Near-zero emission with CO₂ capture and storage
 - Link to Hydrogen issues or long term sustainable `vision`
- Must include aspects of
 - Research and technology development
 - Component and system validation
 - Demonstration/`Lighthouse` Projects

Must embrace non-technical issues as well as technical



Structure and Interactions

Products

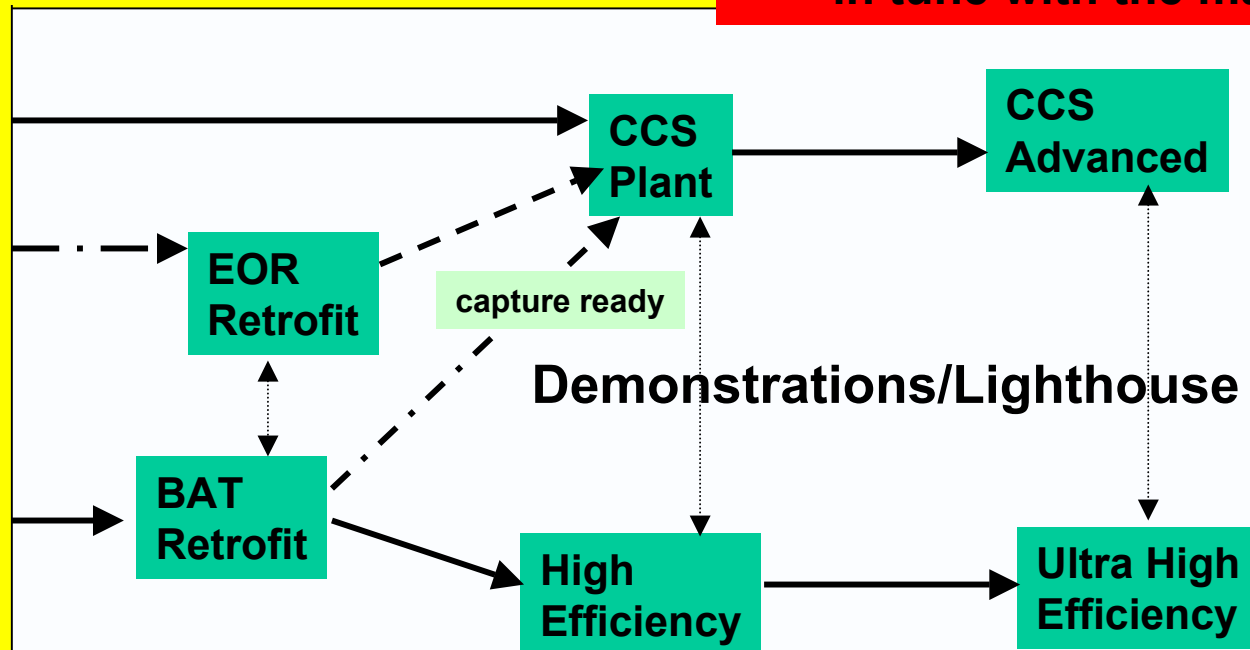
CARBON ABATEMENT TECHNOLOGY PROGRAMME

Collaborations and Technology Transfer

Any development needs to be in tune with the market

Engineering Preparation Studies for Potential Demonstration Plant

and linked programmes



2005+

2010+

2020+

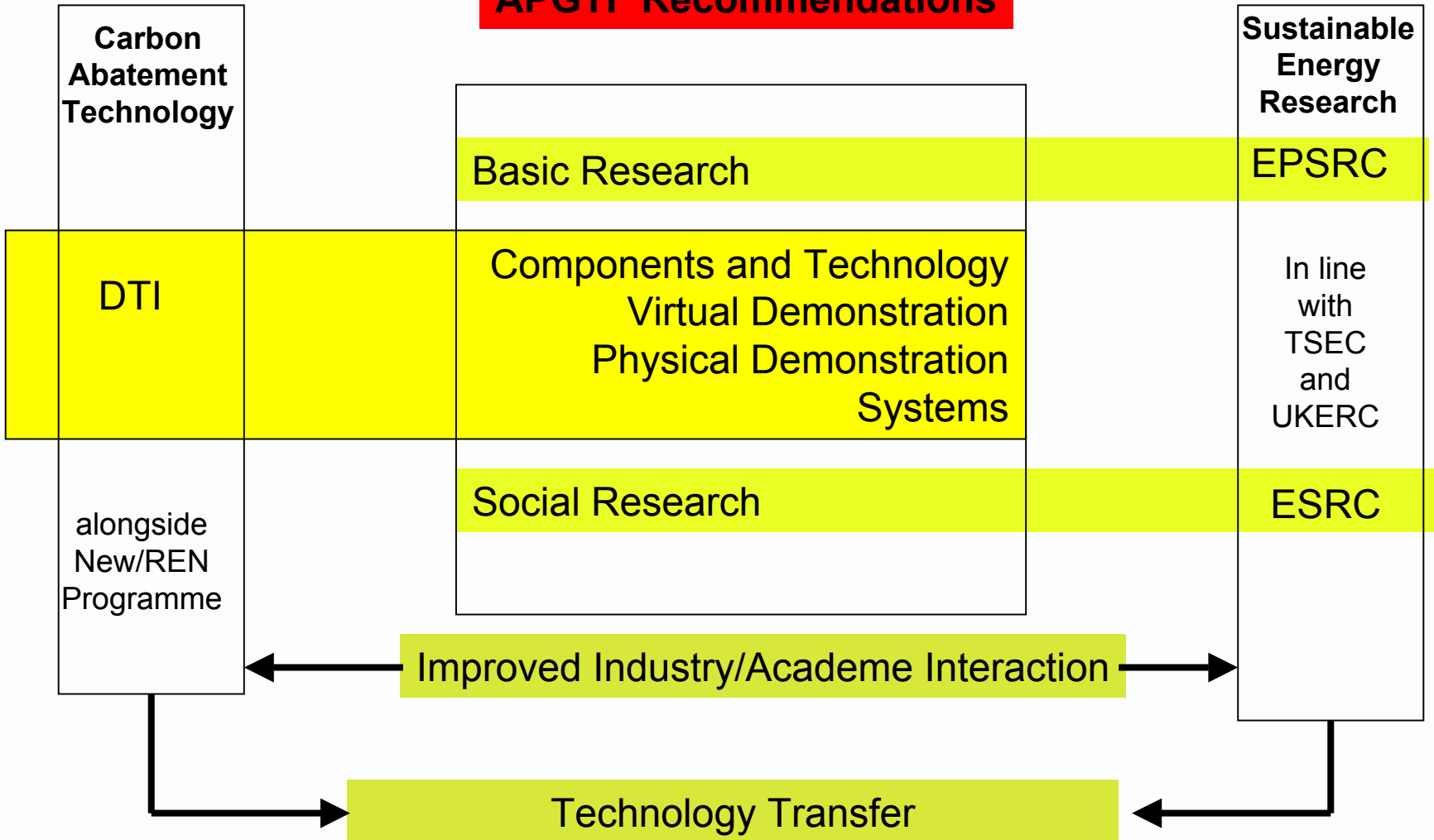
UNDERPINNING UNIVERSITY RESEARCH



UK CAT Programme



APGTF Recommendations





- **Industry-driven RD&D Programme**

- existing programmes to continue
- engineering/economics studies for demos
- participation in international programmes

- **Technology Transfer**

- engage future customers + export opportunities
- examine `enablement` issues

- **Academe Research Programme**

- feed into Research Councils/TSEC/etc and UK Energy Research Centre

- **Measures for closer industry/academe cooperation**

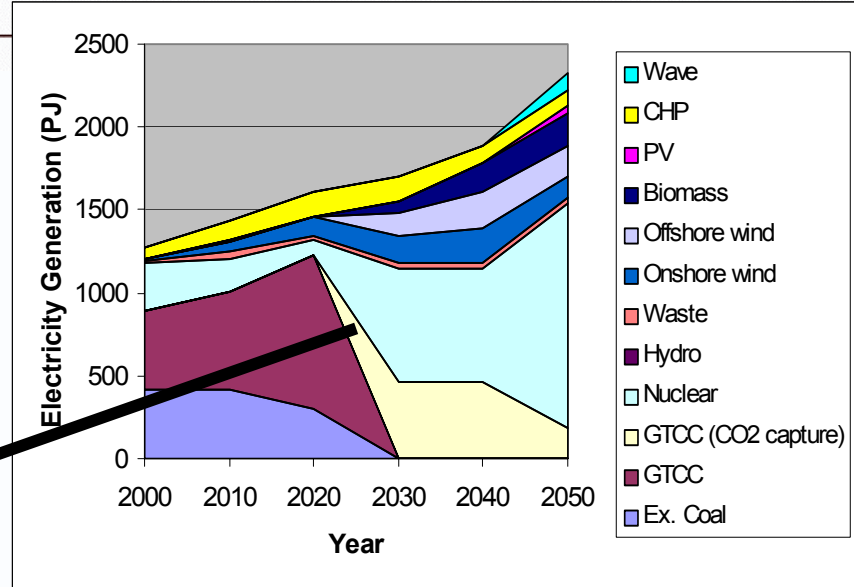
- encourage development of new technologies and skills



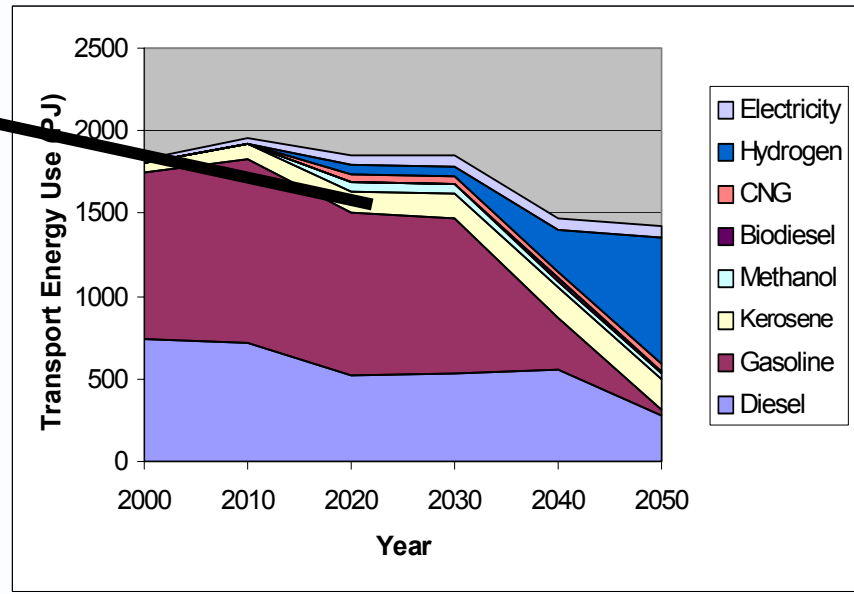
EWP DII Techno-Economic Studies : Time Issues



Fuel Mix in Electricity Generation - 60% CO₂ Reduction in 2050 (limited Energy Efficiency)



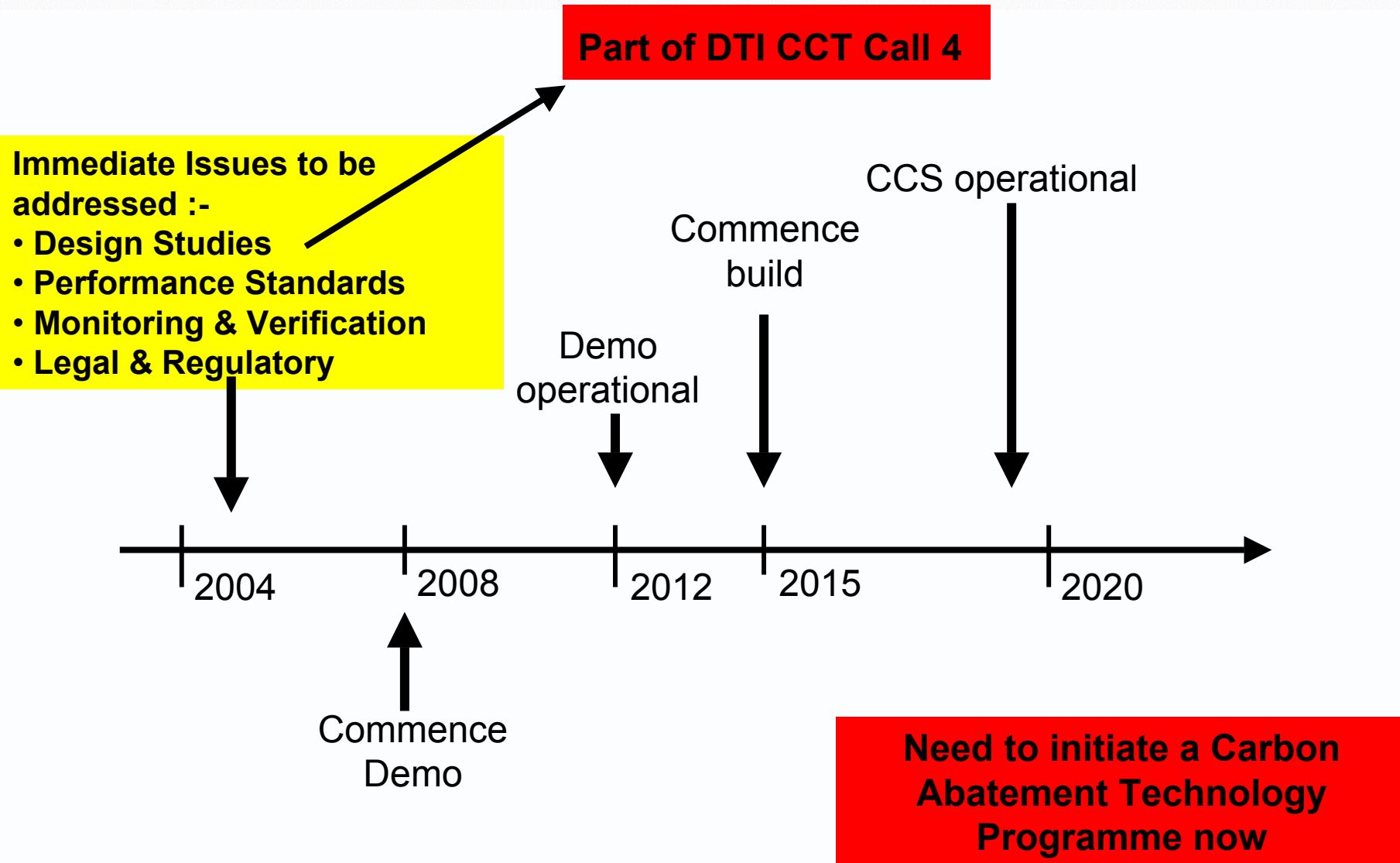
Importance of CCS and Hydrogen Technologies in 2020-2030



Fuel Mix in Electricity Generation - 60% CO₂ Reduction in 2050 (limited Energy Efficiency)

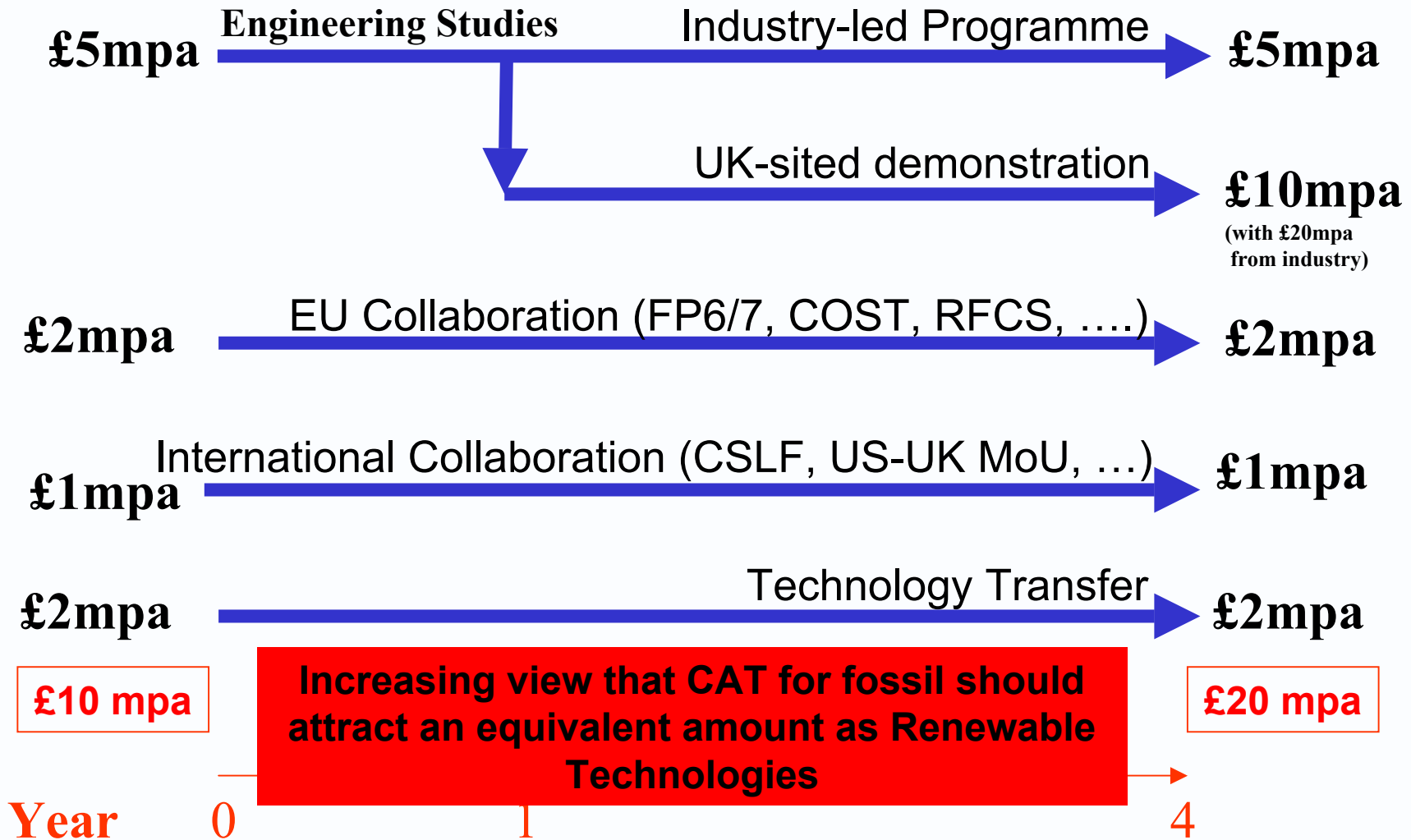


Indication of Timeline for UK





Possible level of UK Government Funding Support





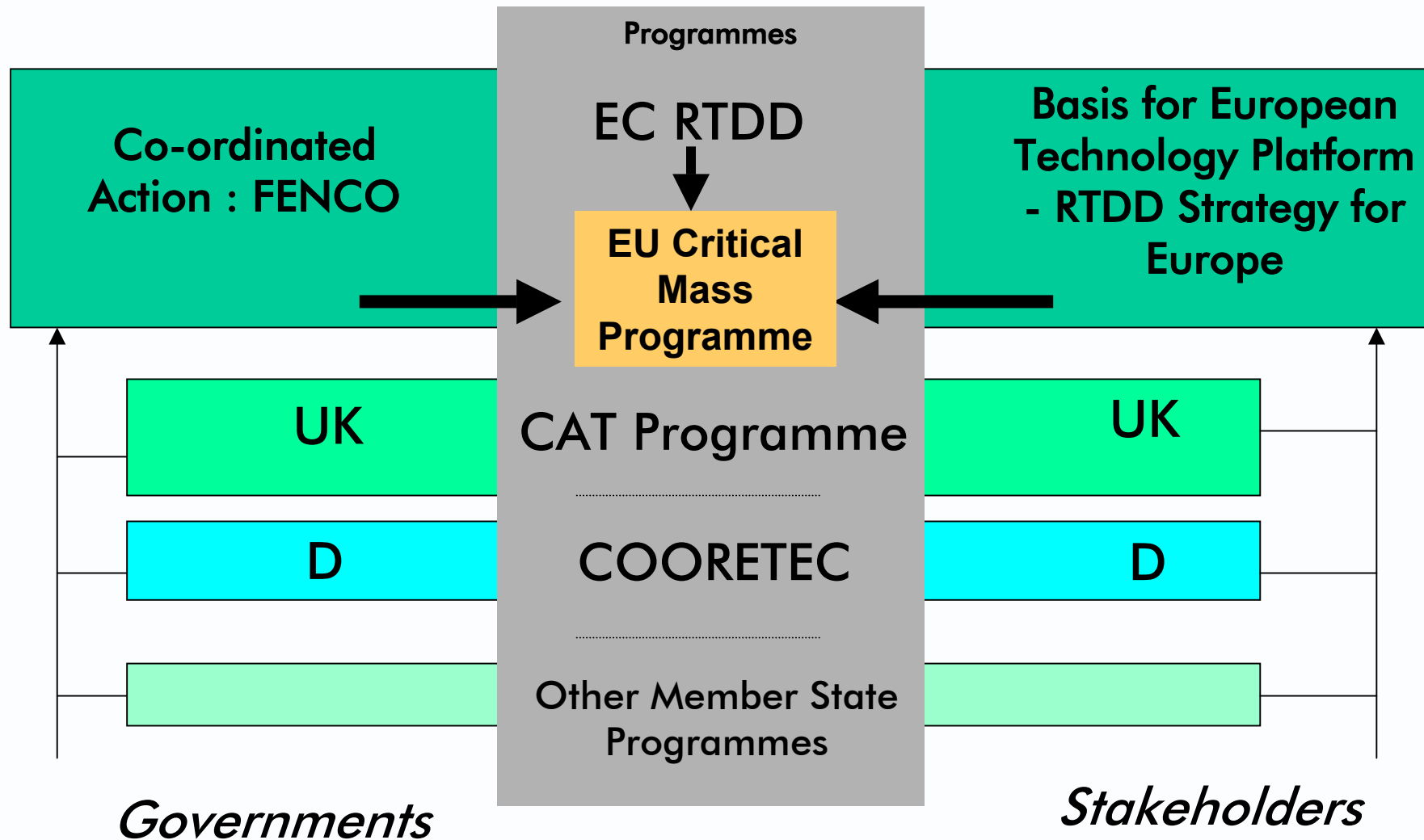
• EU/EC Initiatives

- **FENCO** : pan-EU government action on Clean Fossil PG
- **POWER21** : EU industrial initiative to establish technology priorities for European critical mass programme on Clean Fossil PG including demonstration requirements
- **EC FP6** : move towards IPs and possible `Lighthouse Projects`
- **EC COST** : follow-up Materials RTD action for steam and gas plant
- **EC Networks** : Clean Power Systems - POWERCLEAN
Gas Turbine Systems - CAME-GT
CO₂ Capture/Storage - CO2NET₂
- **EC Technology Platform** : Hydrogen and Fuel Cells
- **EC Quick Start Projects** : HYPOGEN initiative

Potential for proactive role for UK within Europe

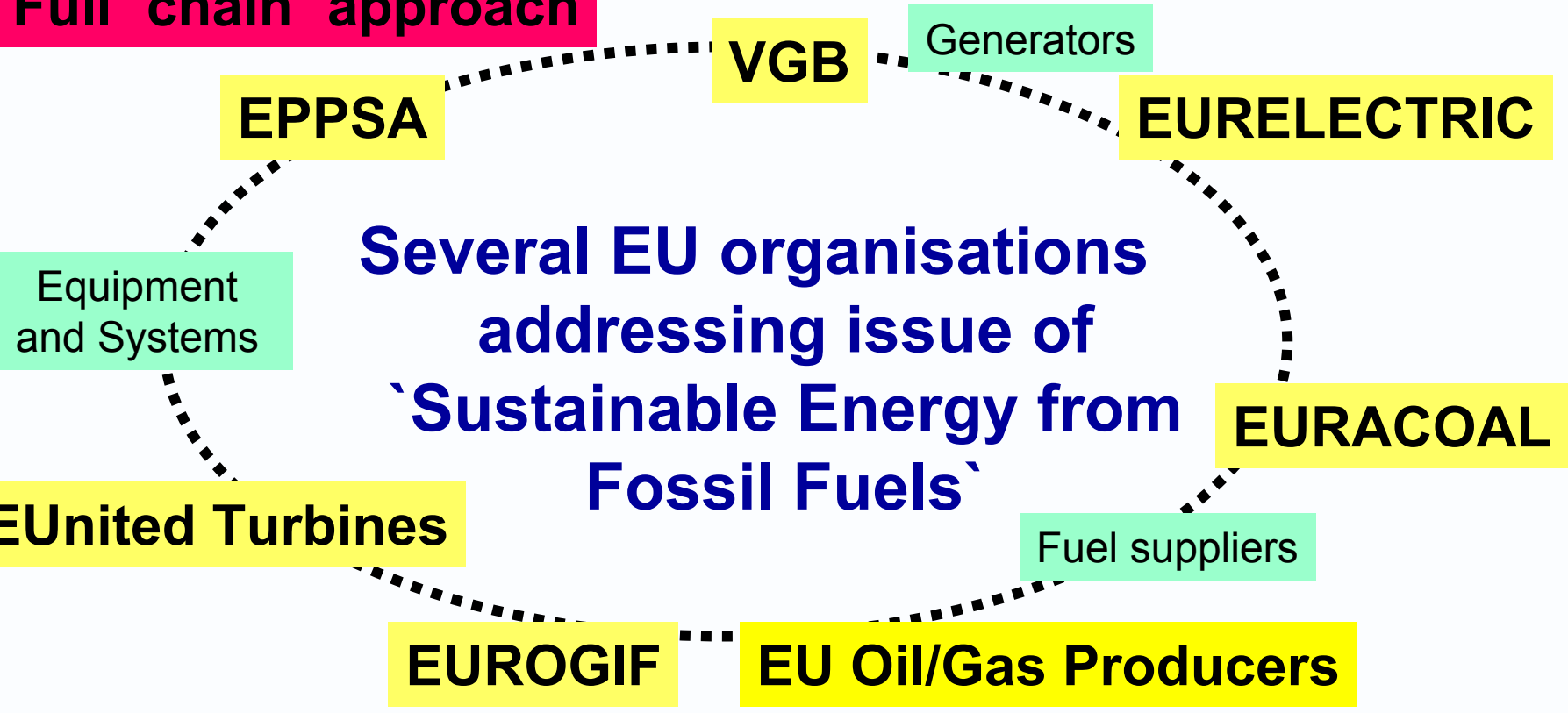


EU "Critical Mass" Initiative for Carbon Management of Fossil Fuel





Full `chain` approach

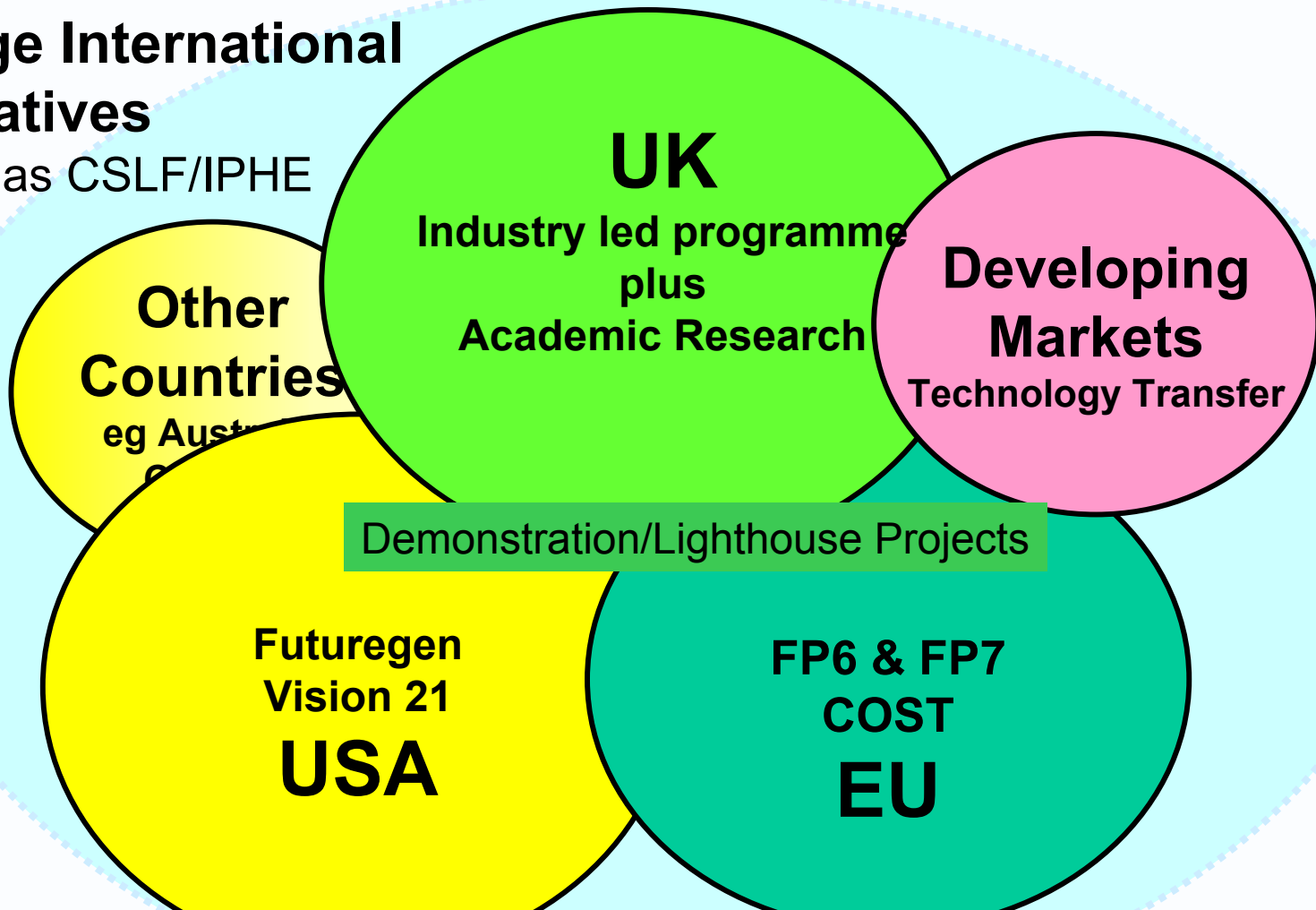


Meetings in October-November/04 to take forward initiative



Large International Initiatives

such as CSLF/IPHE



Collaboration needs to be an essential `CAT` element



Some Concluding Remarks



- **‘Uncertainty and Change’ will continue**
 - difficult to forecast future; no one single winning technology; broad balanced portfolio approach
 - fossil fuels will continue to play a major role for decades yet
 - clean use of fossil will be a key transitional issue
 - impact of a real value for CO₂ - Emission Trading/Tax implications; market could change dramatically
 - really tough to get new advanced technologies into the market place
 - ⇒ consistent policy for confidence to underpin private sector investment and RTD
 - ⇒ correctly targeted market based measures/incentives for technology take-up



● 2005 - a Year of Opportunity for UK

- upcoming leadership of G8 and the EU
- real chance to influence on the European and world arena
- importance of Global Climate Change
- engagement of Emerging Market Economies

butit needs to be done from a position of strength requiring

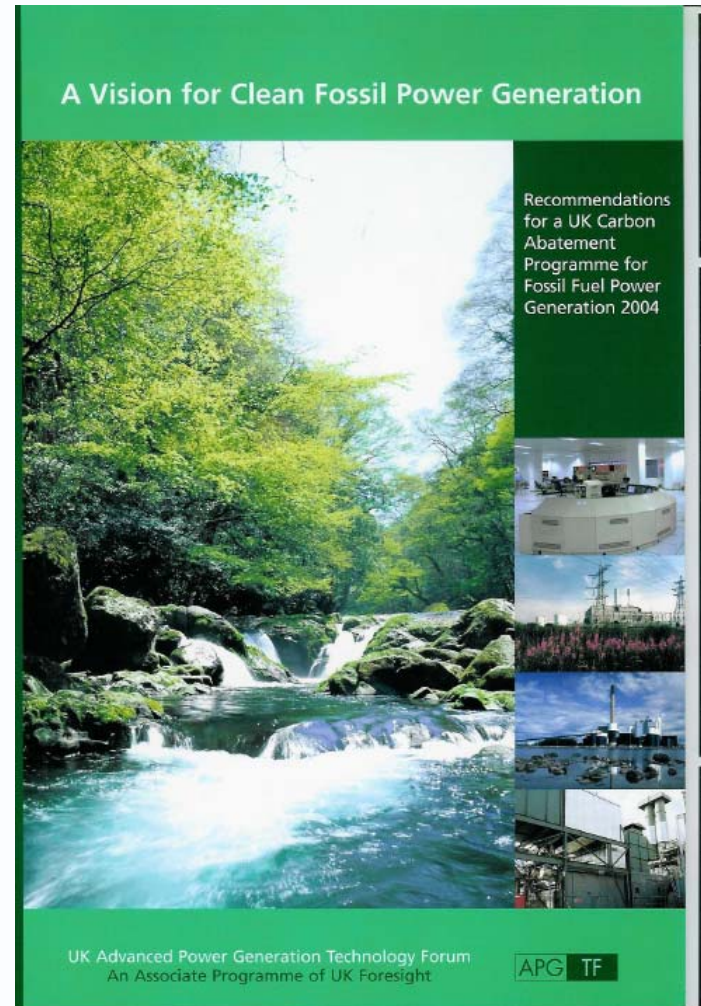
- definition of UK CAT strategy recognising the importance of collaboration - within UK, within Europe and in full international scene
- backed up by a `reasonably sized` CAT government programme to provide the `springboard` for industry
- complementary to and alongside other energy technology initiatives

Innovation and continued technology development will be essential to meet the complex demands of the future



APGTF STRATEGY FOR TECHNOLOGY RD&D IN FOSSIL POWER GENERATION

www.apgtf-uk.com



The Alstom logo features the word "ALSTOM" in a bold, blue, sans-serif font. The letter "O" is replaced by a red circular graphic consisting of three concentric, slightly offset rings, creating a sense of motion or a stylized eye. The logo is centered within a white, semi-circular shape that is bordered by a thick red arc on its upper edge. The background consists of vertical blue stripes of varying shades, with some faint white curved lines overlaid.

ALSTOM

www.alstom.com