



# **North West Energy Forum**

In Partnership with **Envirolink Northwest**

## **Nuclear: Current and Future Opportunities**

8<sup>th</sup> February 2007  
Swallow Hotel, Preston



# **North West Energy Forum**

In Partnership with **Envirolink Northwest**

**Peter Jones**

**President**

**North West Energy Forum**



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In Partnership with **Envirolink Northwest**

**Joe Flanagan**

**NWDA**



# Nuclear Opportunities

**Joe Flanagan**

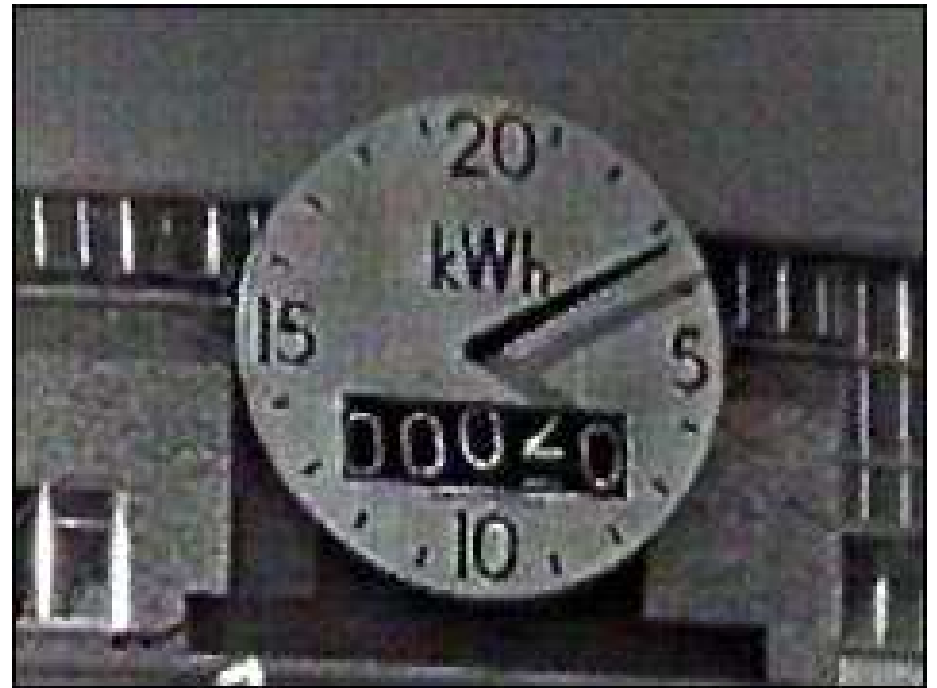
**NWDA Sector Leader Energy and Environmental Technologies**

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**01925 400332**

**17<sup>th</sup> October 1956 - The Queen opens the world's nuclear power station, at Calder Hall in Cumberland.**

**The Lord Privy Seal, Richard Butler; "It may be that after 1965 every new power station being built will be an atomic power station."**



**And then ....**

**Windscale**

**Three Mile Island**

**Chernobyl**



**But.....**

- **Growing realisation of the difficulty of meeting GHG targets**
- **Reactor technology has advanced**
- **UK is committed to addressing the issues of decommissioning and radioactive waste management**



- All elements of the nuclear fuel cycle are represented in the NW
- Approx 23,000 people employed in the sector (50% of UK total)
- Contribution to NW GVA ~£2bn (2% total)
- Large concentration of R&D facilities and capabilities
- £1.4 bn of NDA's expected spend of £2.2 bn (2006/7) will be in the NW



# The opportunities

**Decommissioning: UK £63bn, World \$300bn+**

**New build UK: 10GW, £2bn**

**Waste Repository; £6-10bn**



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**Martin Robb**

**NDA**



Nuclear  
Decommissioning  
Authority

# The NDA Research and Development Encouraging Innovation

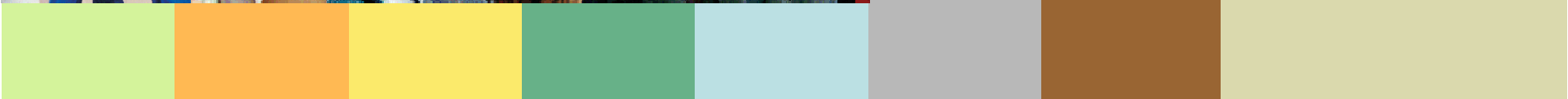
*Supporting Environmental Restoration*

*Martin Robb*

*Regional Development Engineer, Magnox North, NDA*



[www.nda.gov.uk](http://www.nda.gov.uk)

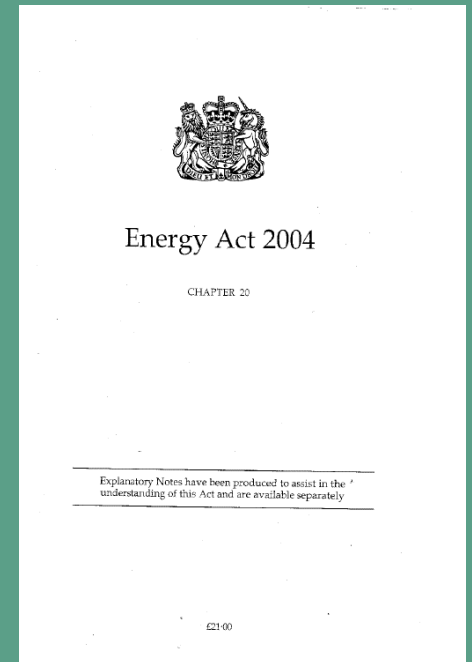


# Research and Development – NDA

Energy Act places requirement on NDA to:

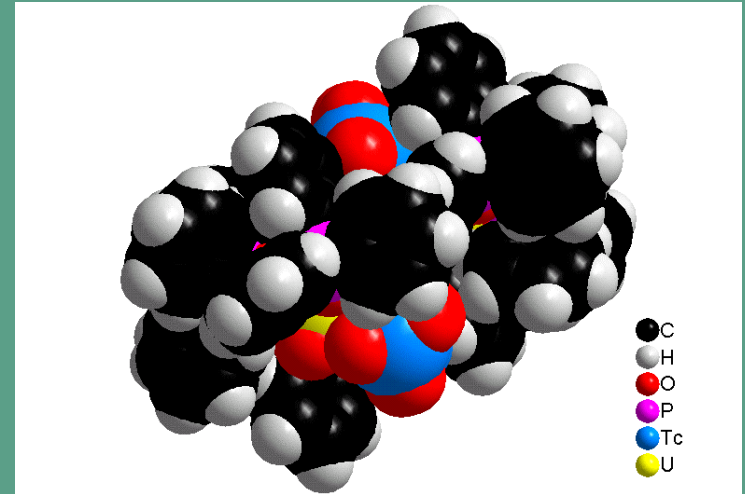
Invest in R&D to support mission

- Co-ordinate clean-up R&D across the UK
- Encourage innovation
- Maintain skills in research areas
- Underpin strategy



# Research and Development

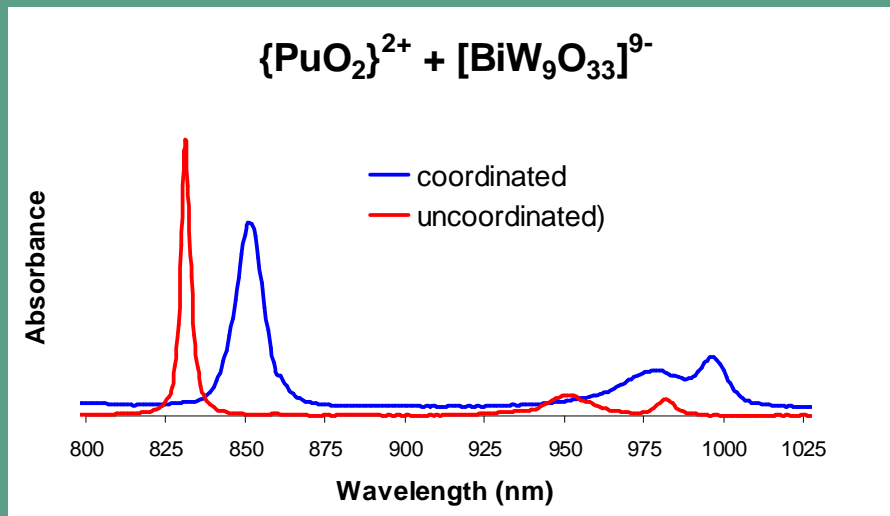
- Site License Companies (SLC) are accountable for conducting R&D programmes to deliver the LCBL - innovative improvements.
- The majority of NDA R&D will be conducted by the SLC as an integral part of LCBL activities.
- Requirements for identification of these R&D plans are described in the NDA Procedure – Lifecycle Baseline requirements



U – Tc Complex formed in Purex process  
Courtesy University of Manchester

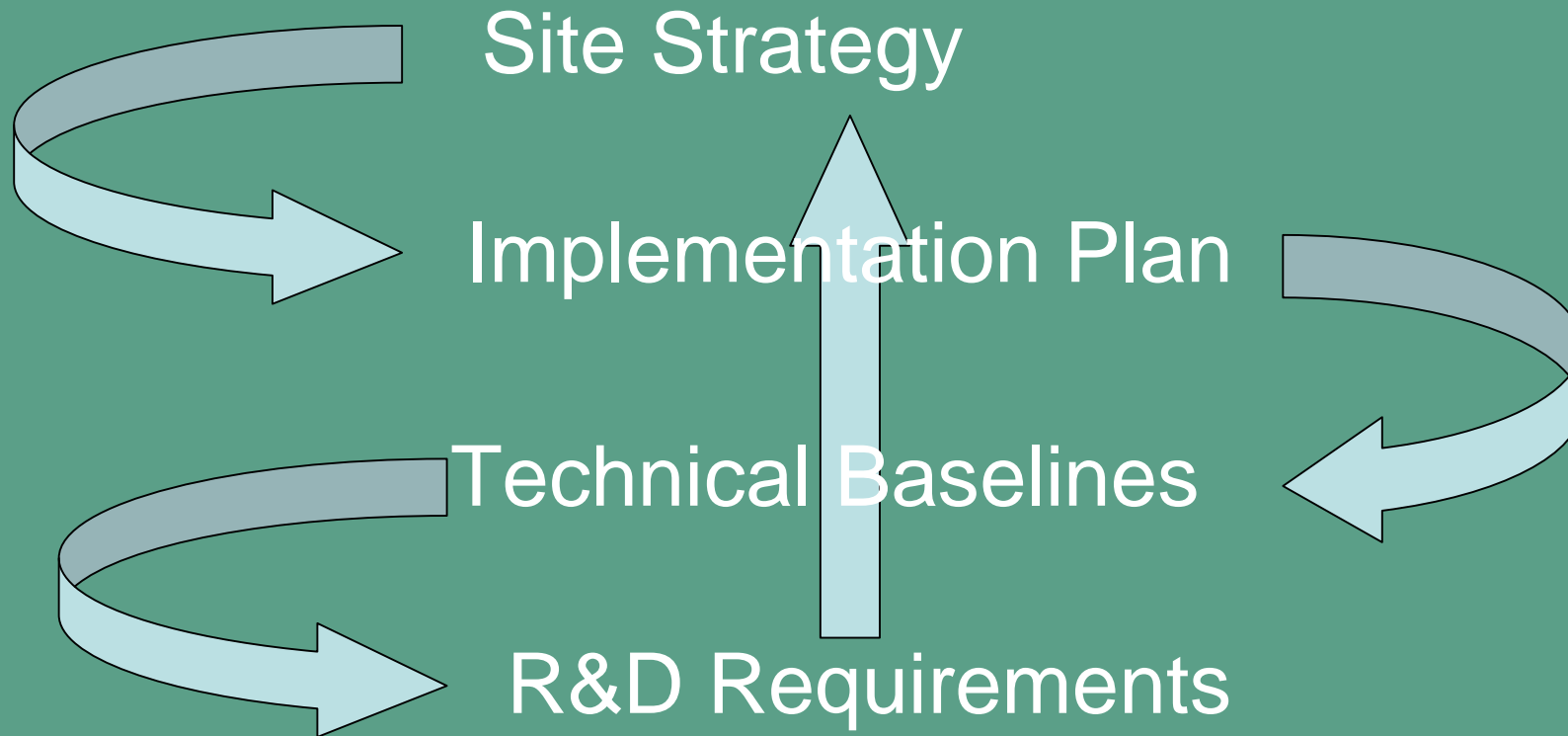
# Research and Development - NDA

Plutonium Coordination  
Courtesy University of Manchester



- NDA will establish direct contracts with organisations to support R&D activities when generic to a no. of our sites
- Output of R&D all activities will be made available to other organisations that are delivering work scope on NDA sites
- NDA will annually produce an overview of R&D activities supported by the NDA

# Lifetime Plans



# Innovation

**Business Pull**

LTP



**Technology Push**

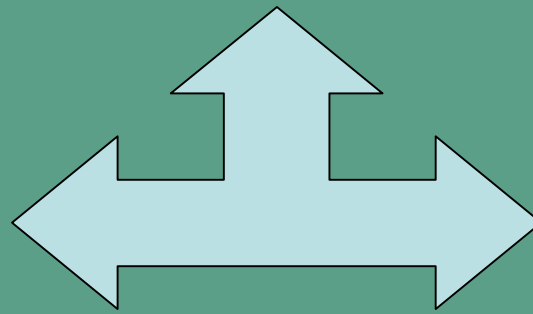
# Technical Maturity – TRL's

- 9 Actual System Proven through technology application
- 8
- 7 System prototype demonstration in an operational environment
- 6
- 5 Component and/or bench validation in relevant environment
- 4
- 3 Analytical and experimental critical functions and/or characteristic proof of concept
- 2
- 1 Basic principles observed and reported

# The Research & Development Market – SLC's

SLC – Produce Needs, Risks, Opportunities

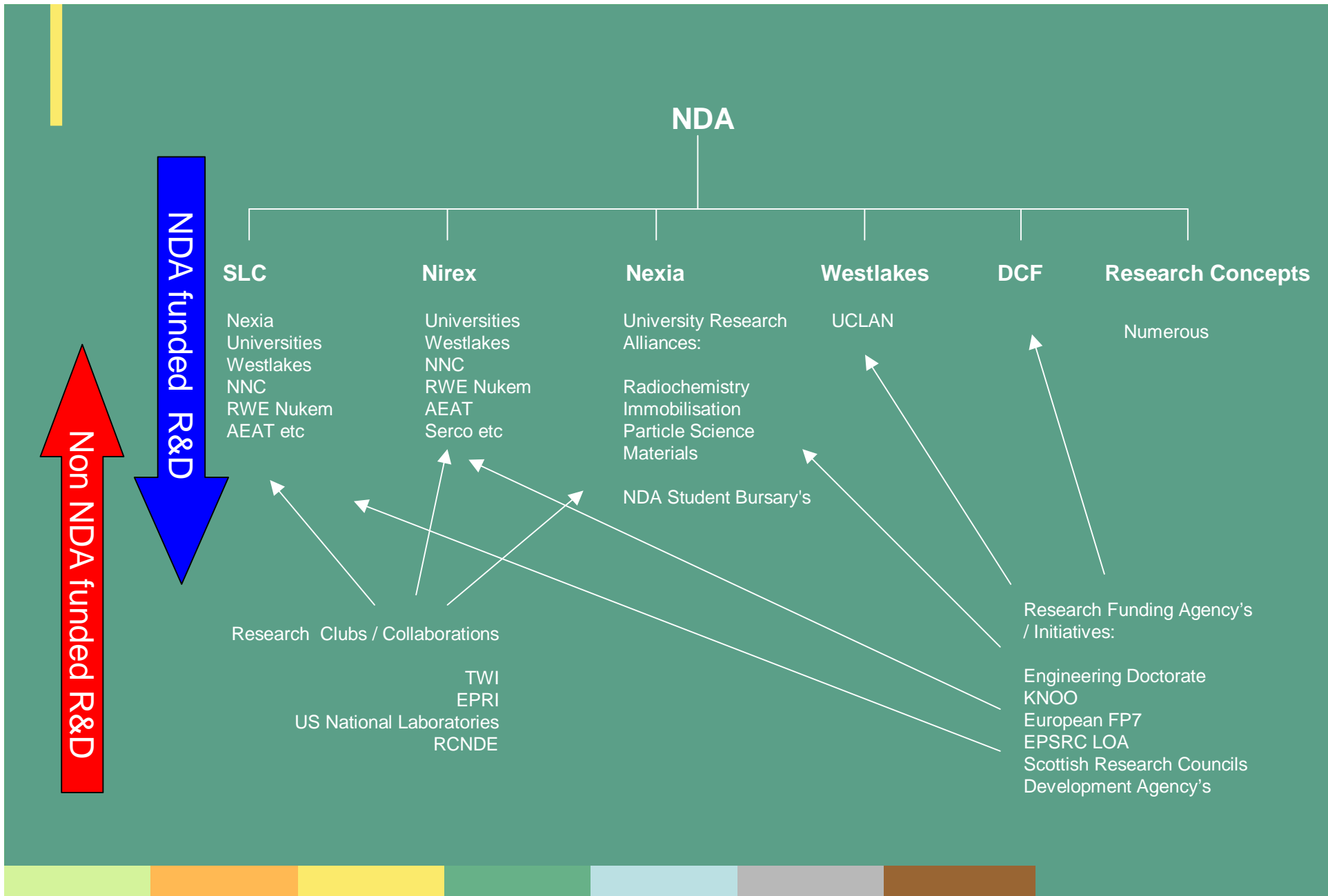
Competition of  
Research Packages



Innovations resulting  
From Publication of  
LTP – including  
Needs, risks,  
opportunities

Skills Maintenance Obligation underpinning all specific activities

Majority of R&D spend by SLC





# The Research & Development Market – NDA – Direct Portfolio

- Direct Contract with Nexia Solutions – Underpinning key skills pending National Laboratory Debate
- Provide funding to Nirex
- Open competition for specific packages
- Call for proposals – Innovation
- Call for proposals – Fully funded PhD bursary's



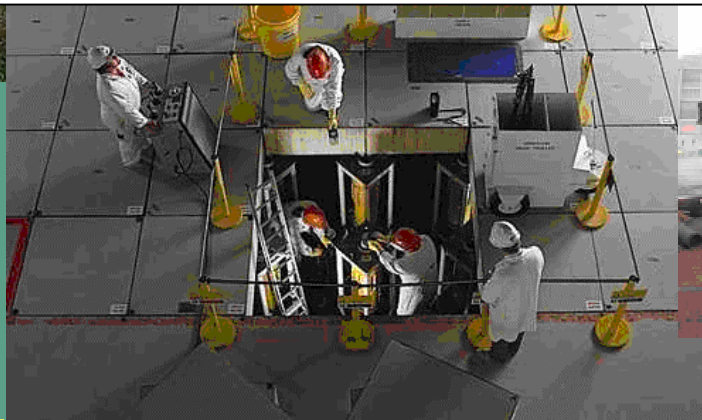
# Conclusions

- Openness and Transparency in R&D market
- Availability of skills key issue
- Opportunity for the scientific community from fundamental science to operations
- Call for Proposals – Encourage innovation

# Watch This Space!!!



[www.nda.gov.uk](http://www.nda.gov.uk)



**ANY QUESTIONS?**






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**Gregg Butler**

**IDM**




# Nuclear New Build – a Review of the Issues for potential host communities

**Presentation by Gregg Butler – 8 February 2007**

*Taken from “Energy Issues and Nuclear New Build?” a study  
commissioned by Cumbria Partners, March 2006*

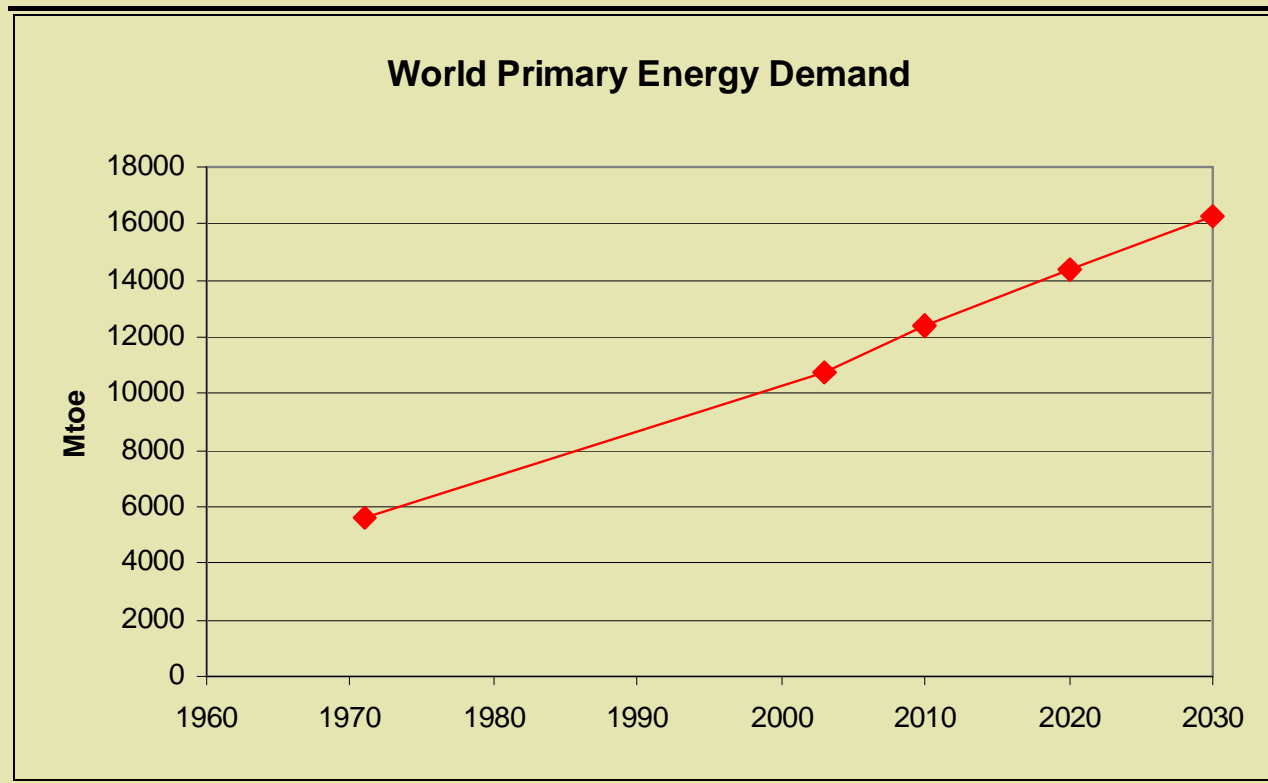
*By Jon Samuel, Peter Wooders (ERM) Grace McGlynn, Gregg  
Butler (IDM)*



# Why an Energy Review?

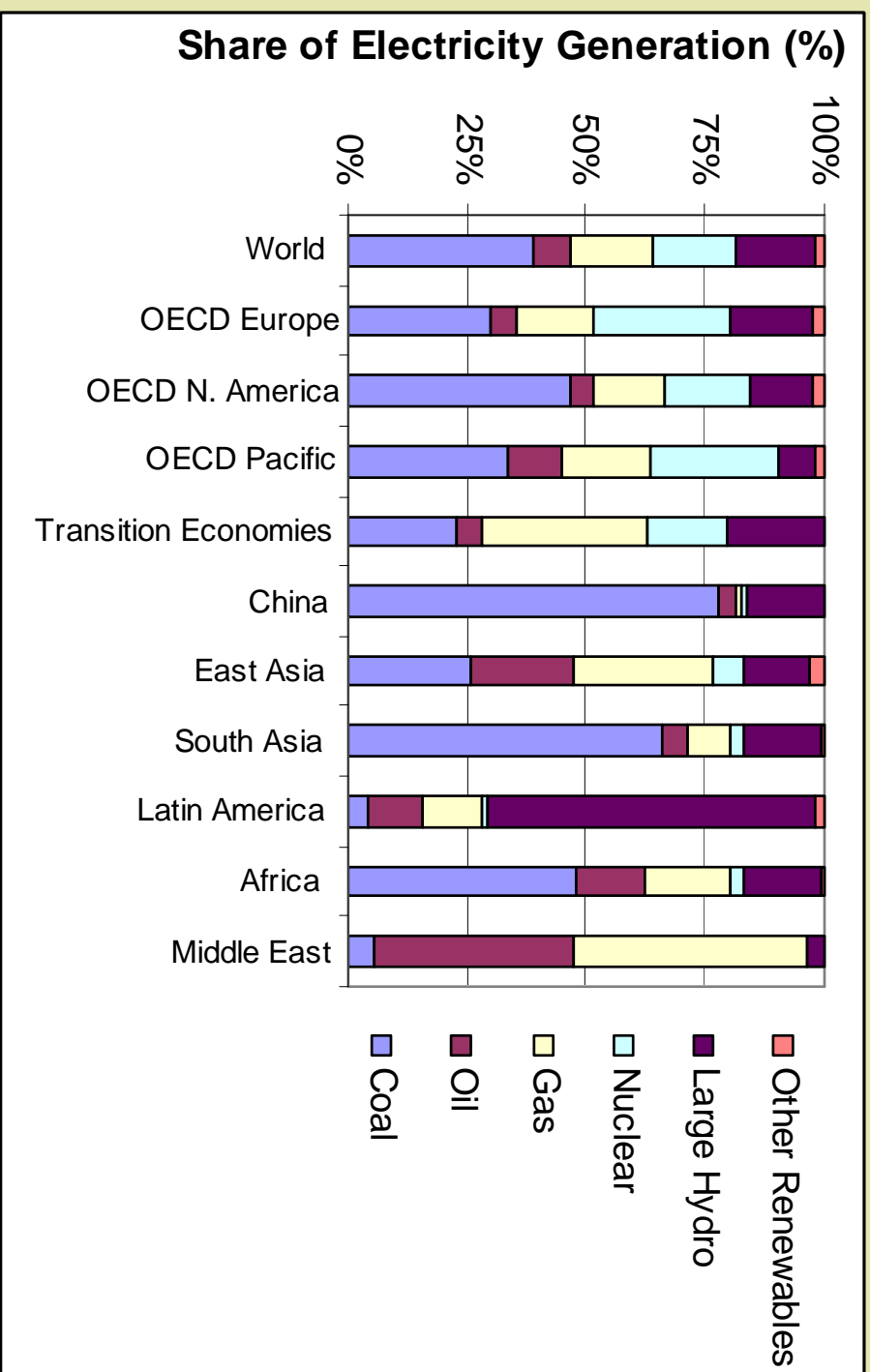
- World Energy & Electricity Context

# World Energy and Electricity Demand Growing

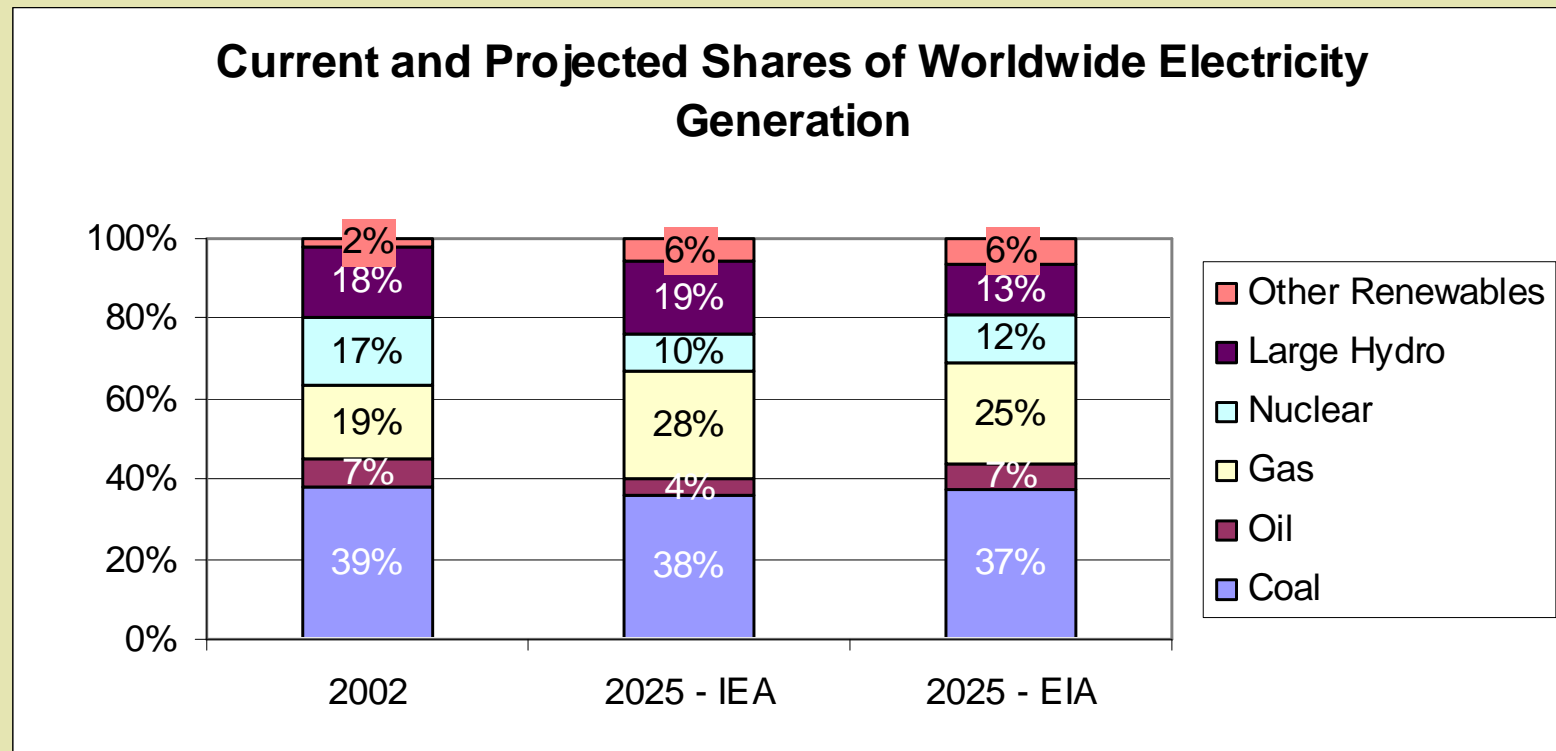


- **International Energy Agency (IEA) project a doubling of electricity demand in the next 30 years**
  - CO<sub>2</sub> emissions projected to see a similar rise

# Electricity Supply Mix Varies Widely



# Future Mix: More Gas, Less Nuclear on Current Trends – Carbon Emissions



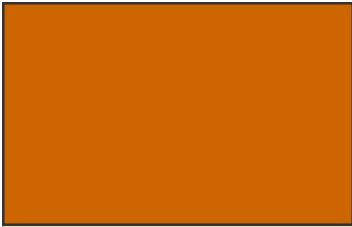
Little change in carbon emissions per unit

# But Fuel Reserves are Limited, and Not Evenly Distributed

Fuel	Reserves (years at current rate)	Location
Natural Gas	>60 years Proven, at current production rates	2/3rds in Russia, Qatar, Iran
Coal	>200 years Economic, at current extraction rates	US, Russia and China >50 percent of recoverable reserves
Uranium	70 years at \$30/lb-U308 at current usage rates; 260 years at \$50/lb U308	Over half current production from Canada and Australia

Source: All figures from IEA World Energy Outlook (2002, 2004 and 2005) unless otherwise stated

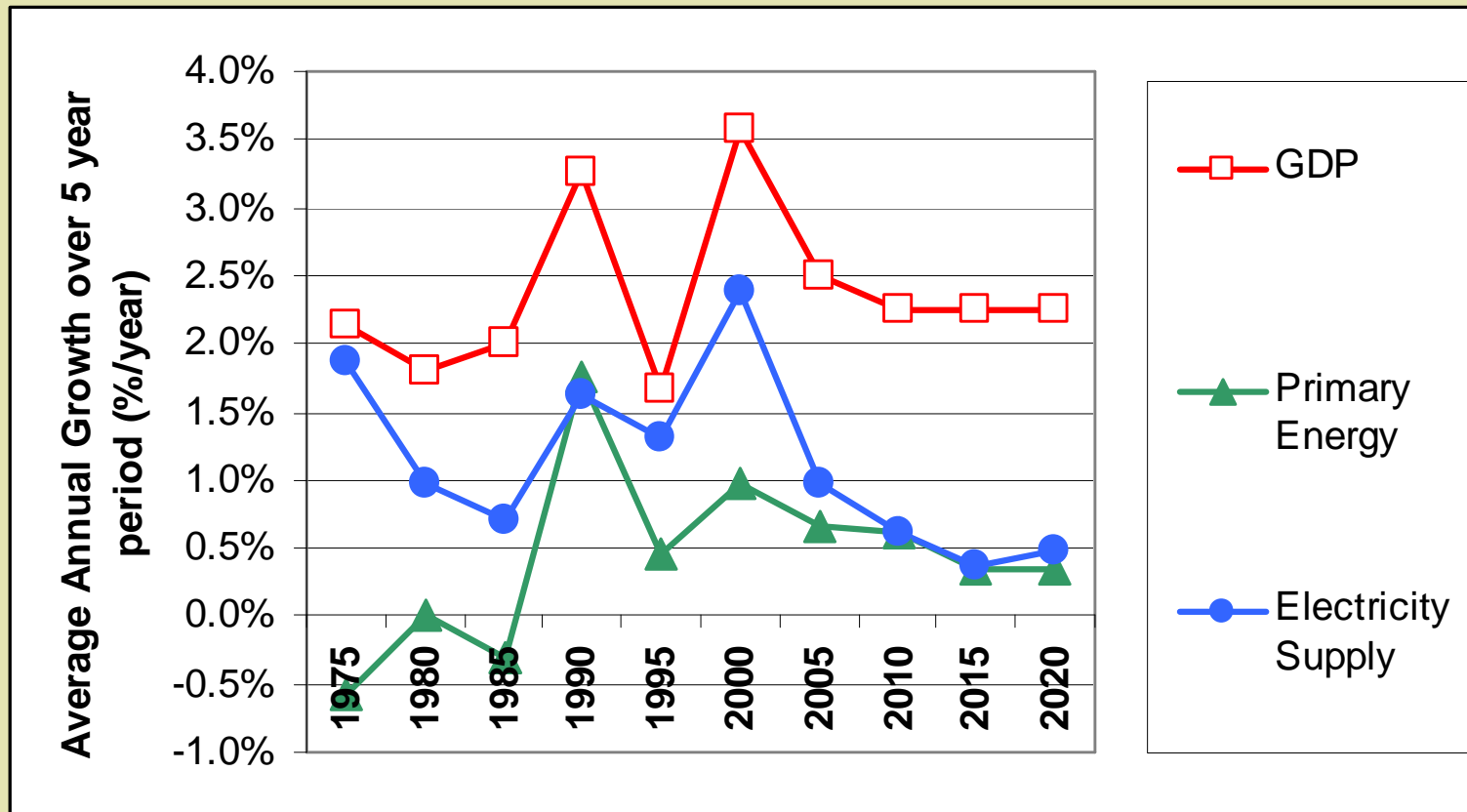
Increasing levels of trade – the UK is part of an increasingly interconnected global energy system



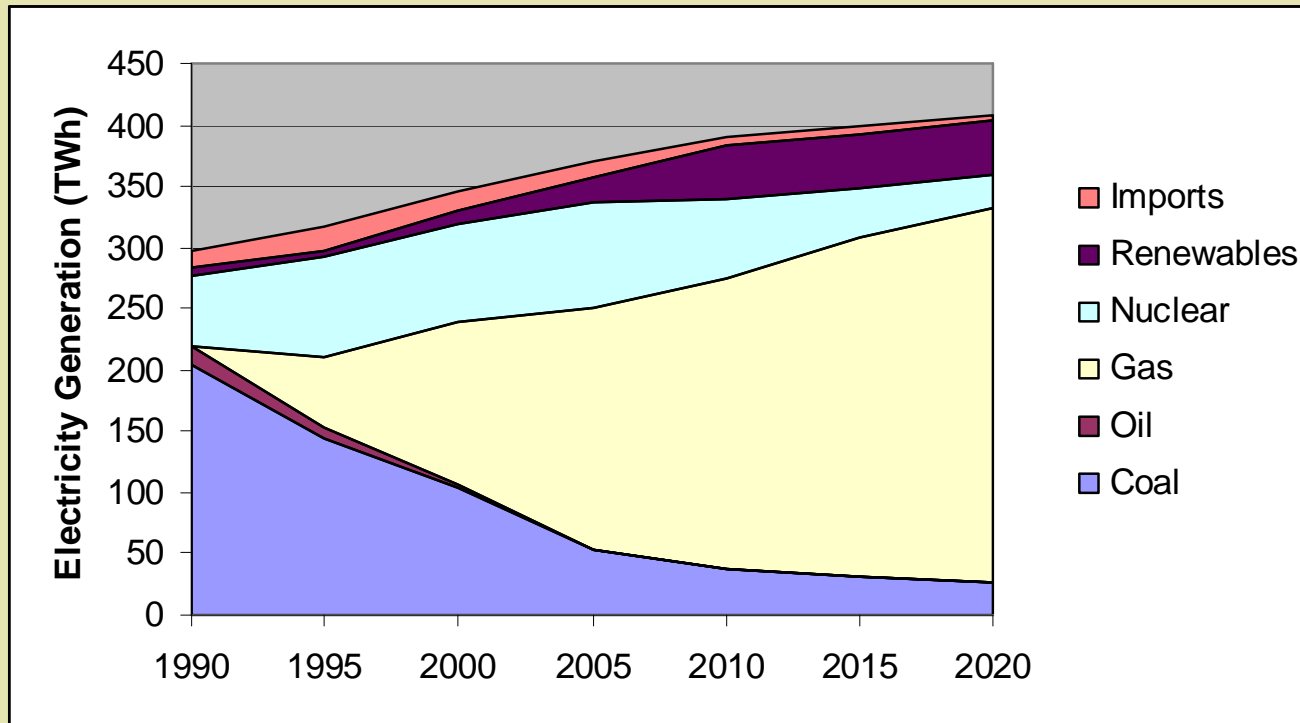
# Why the 2006 Energy Review?

- UK Energy & Electricity Context

# Energy Demand Growing Slowly - with an Increasing Share of Electricity



# Gas is Now the Most Important Source of Electricity – Projected to Increase Further



Source: EP68 [http://www.dti.gov.uk/energy/inform/energy\\_projections/ep68\\_final.pdf](http://www.dti.gov.uk/energy/inform/energy_projections/ep68_final.pdf)

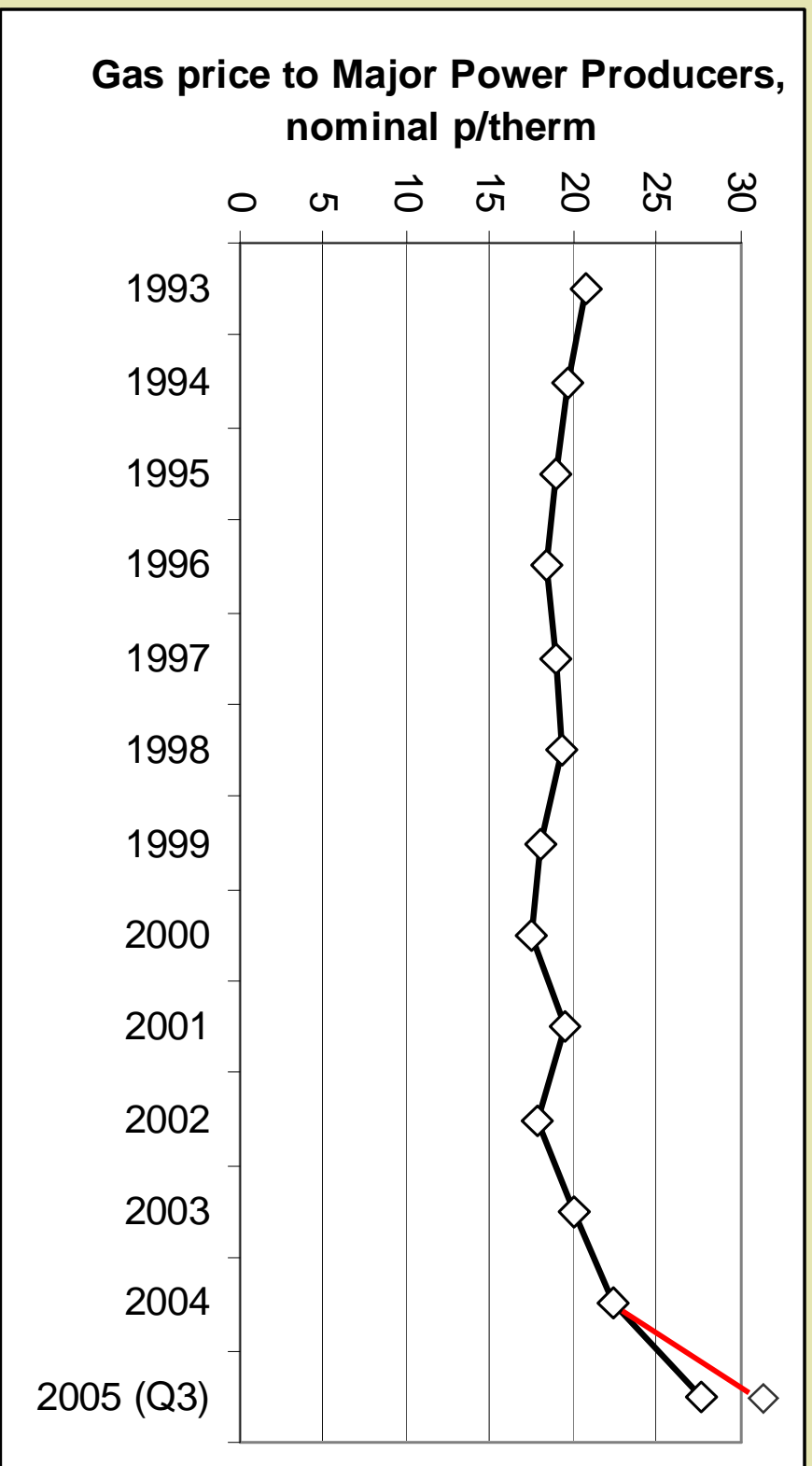
UK moving from gas 'supply = demand' at present to major importer by 2020

**IDM**

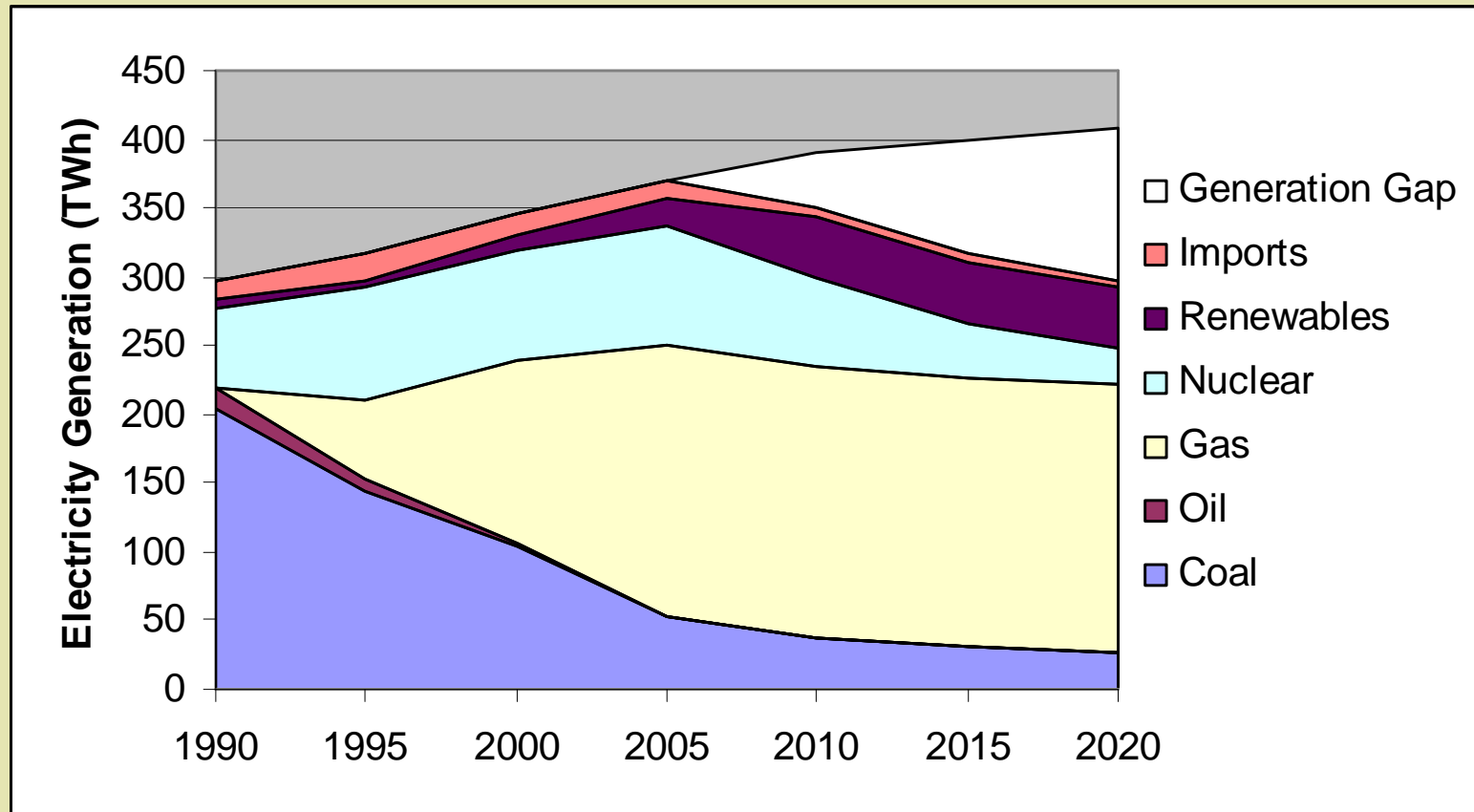
integrated decision management



# Gas Prices Have Risen from Historically Low Levels

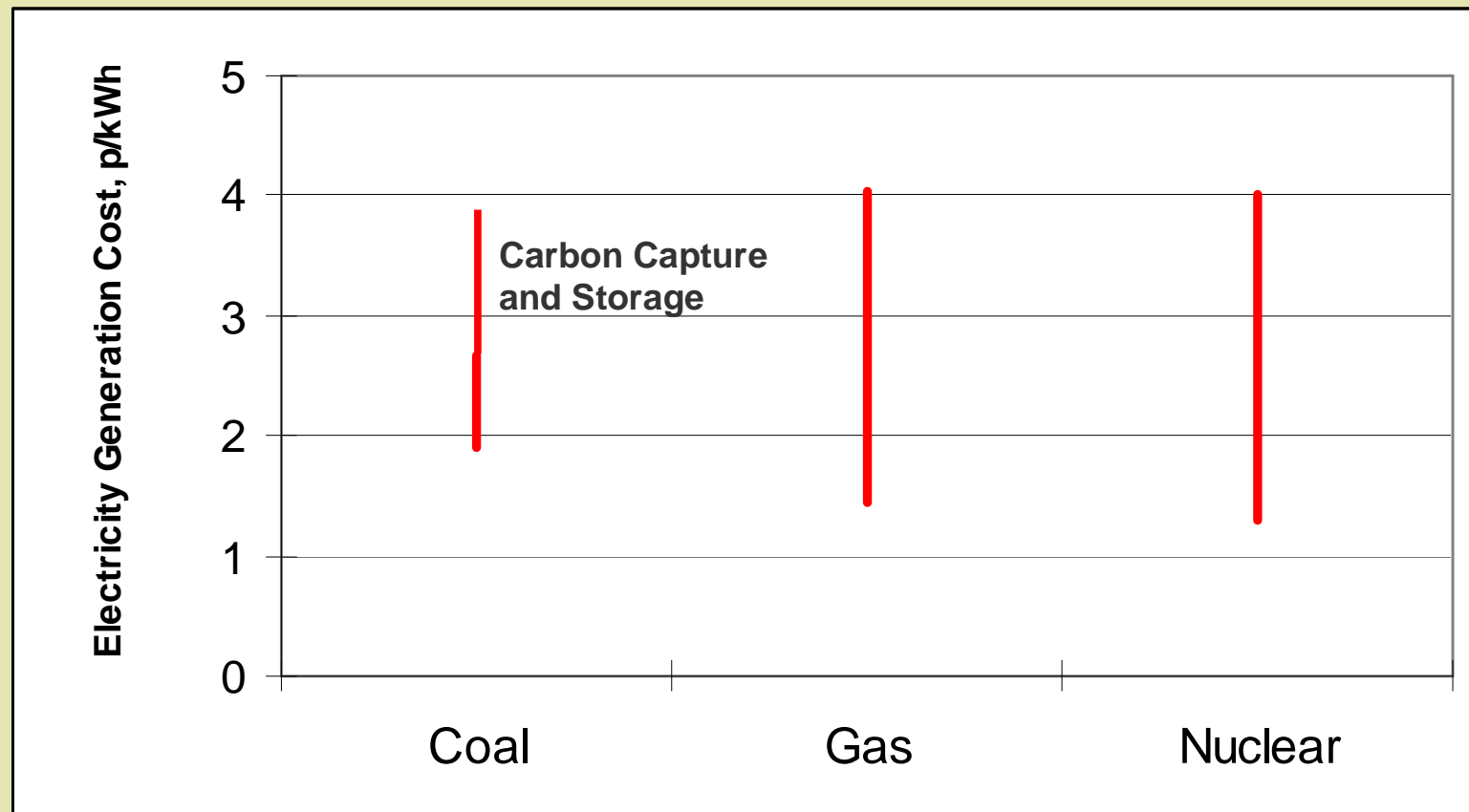


# What if No New Gas Plant Built?



Gap is equivalent to 1.5 GW capacity per year to 2020

# No Bulk Supply Option is Clearly Cheapest



## Hard to Imagine Relying on Only One Option

- **Meeting all new capacity to 2020 alone requires**
  - a level of **coal** generation (using largely imported coal) which would make it very difficult to meet likely future carbon targets
  - levels of **gas** imports which would strongly increase the UK's vulnerability to supply disruptions and/or increases in gas prices
  - approximately 20 replacement **nuclear** power stations
  - 2000 net new 2 MW wind turbines *per annum*
    - 2.5 times current UK wind capacity (+ back up)

# Thus Energy Review 2006

1. What more could the Government do to influence the way we produce or use our energy to ensure we meet our goal of **reducing the carbon dioxide emissions** that contribute to climate change?
2. What further steps should the Government take, if any, to help ensure companies continue to **deliver reliable energy supplies in the long term**?
3. Are there any particular questions the Government should consider when it re-examines the issues relating to **possible nuclear new build**?
4. Are there any particular issues that should apply to the different types of technology that can help **reduce the carbon dioxide emissions from the energy we use**?
5. What further steps should be taken towards meeting the Government's goal for ensuring that **every home is adequately and affordably heated**?

# Energy Review 2006

- **Strengthened EU emissions trading scheme (ETS)**
- **UK on course to exceed Kyoto target**
- **Starting point is energy saving – more information and clearer incentives – drive to raise basic standards of energy efficiency**
- **More energy efficient transport – press for inclusion of road transport in ETS - Cleaner technology and fuels for transport**
- **Distributed energy generation including low carbon heat**
- **Large scale electricity generation – 25 GW over next 20 years**
- **Short term renewables especially wind plus gas fired (20% renewables by 2020)**
- **Coal - study of carbon capture and storage**
- **Major consideration of security of supply**

# Energy Review 2006

- **Propose a clear statement on position of nuclear new build**
- **“Nuclear would make a significant contribution to meeting our energy goals”**
- **Private sector to initiate, fund, construct and operate nuclear and cover full cost of decommissioning and share of long term waste management**
- **Consultation on policy framework for new nuclear build (July 06)**
- **HSE licensing guidance**
- **CoRWM report on waste**
- **White Paper at end of 2006 .....and counting!**



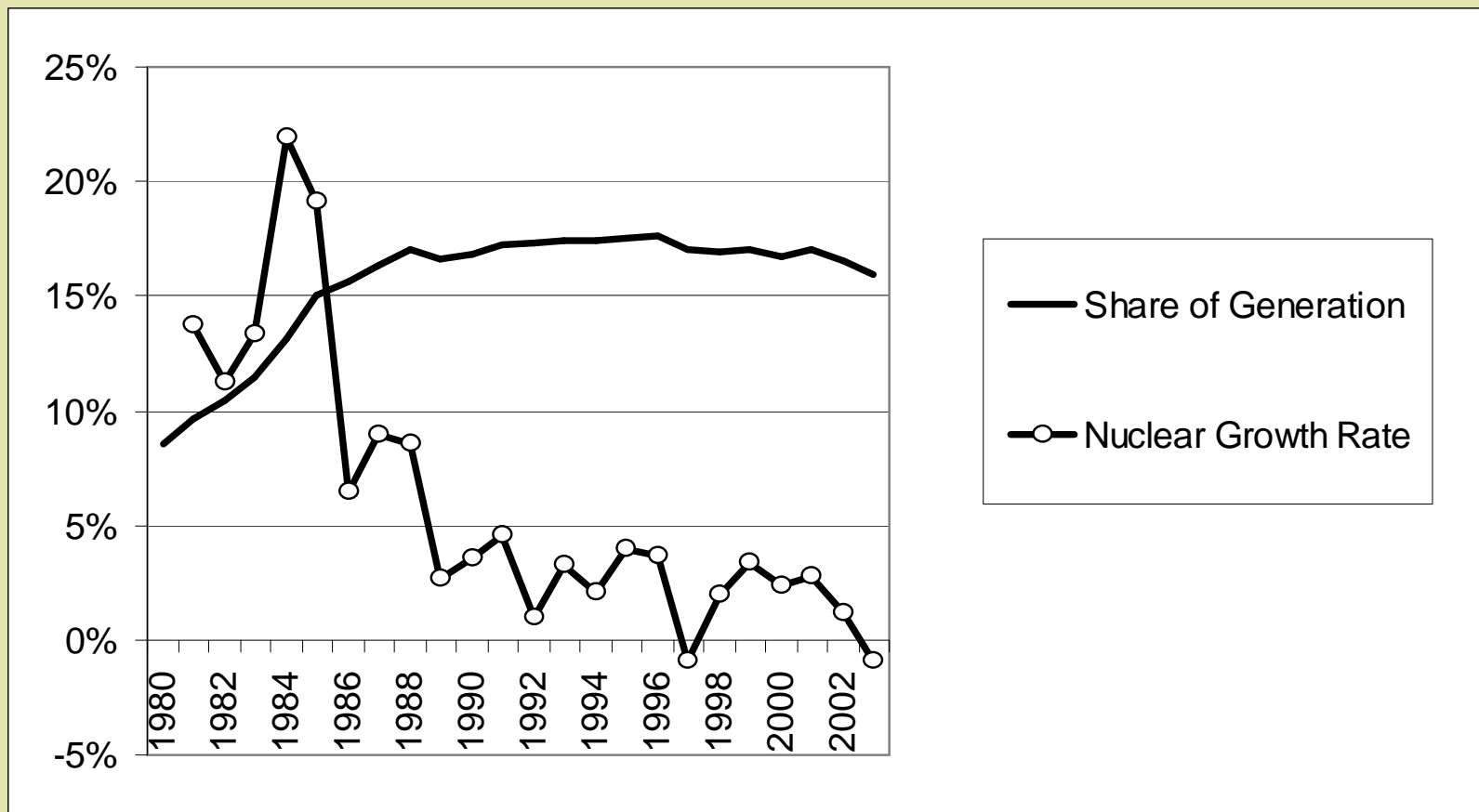
# World Nuclear

**IDM**

integrated decision management



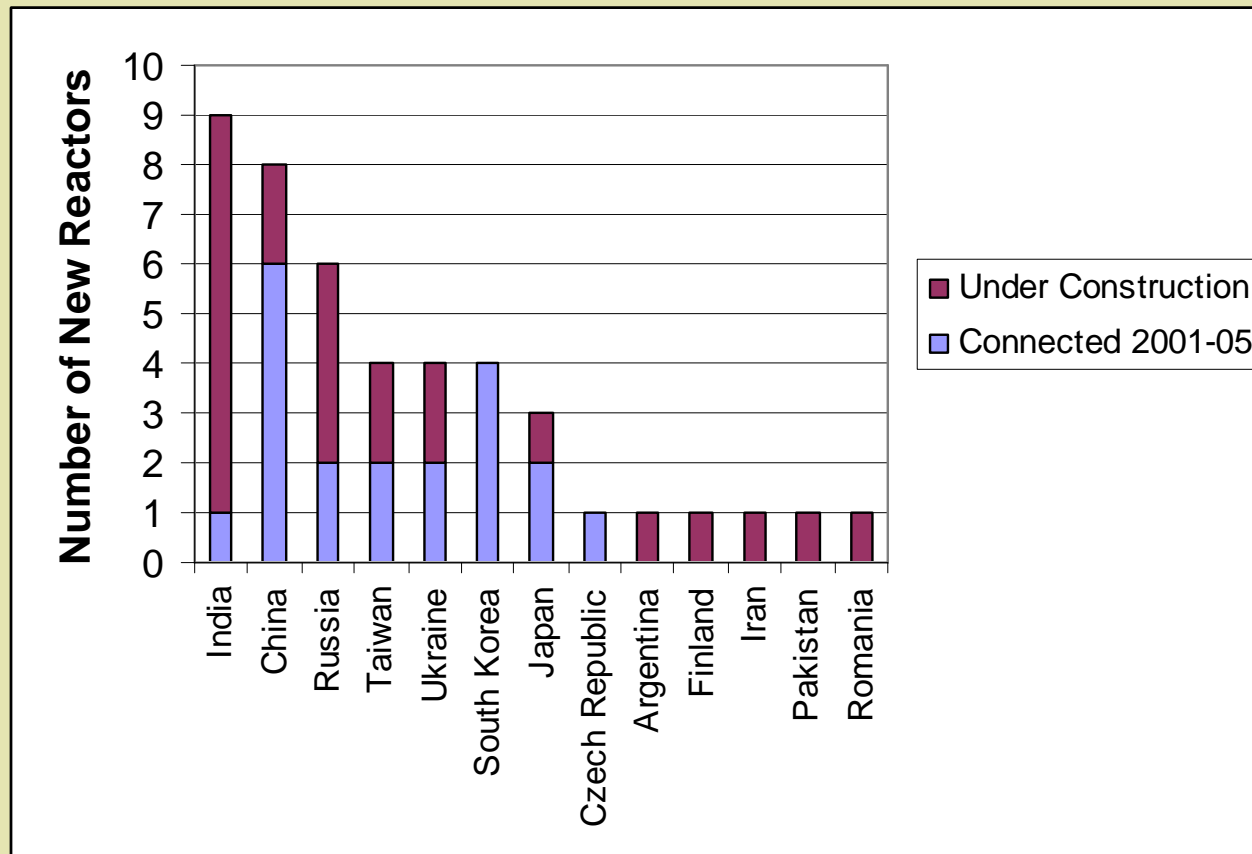
# Nuclear Share Now Declining



# Today's Key Nuclear Generators ...

- **60 percent of the current operational reactors world-wide in**
  - US: 104 reactors operational at end 2005
  - France: 59
  - Japan: 56
  - Russia: 31
  - UK: 23

## ... Are Not Today's Key Constructors



Nuclear new build *is* happening at present.



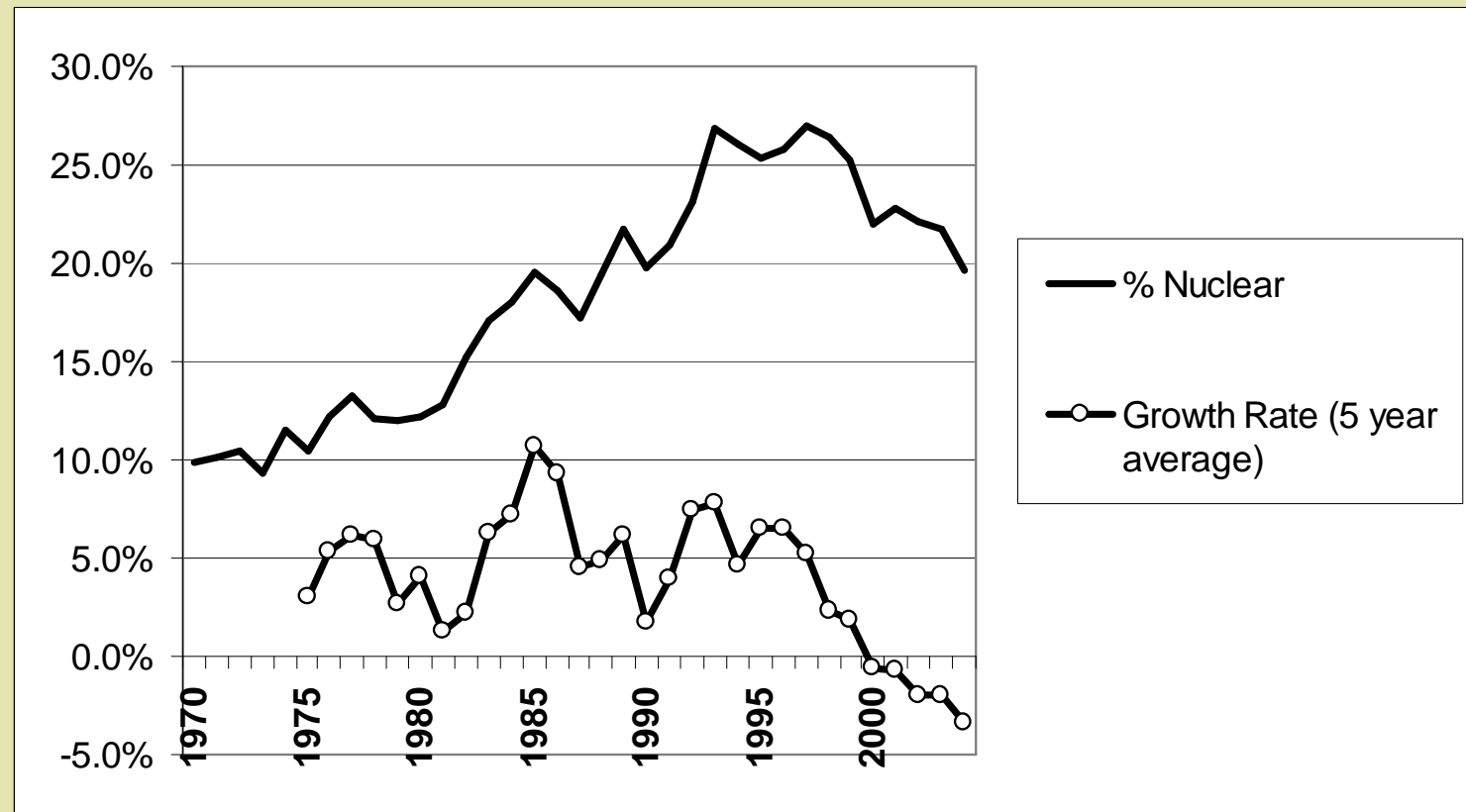
# UK Nuclear

**IDM**

integrated decision management



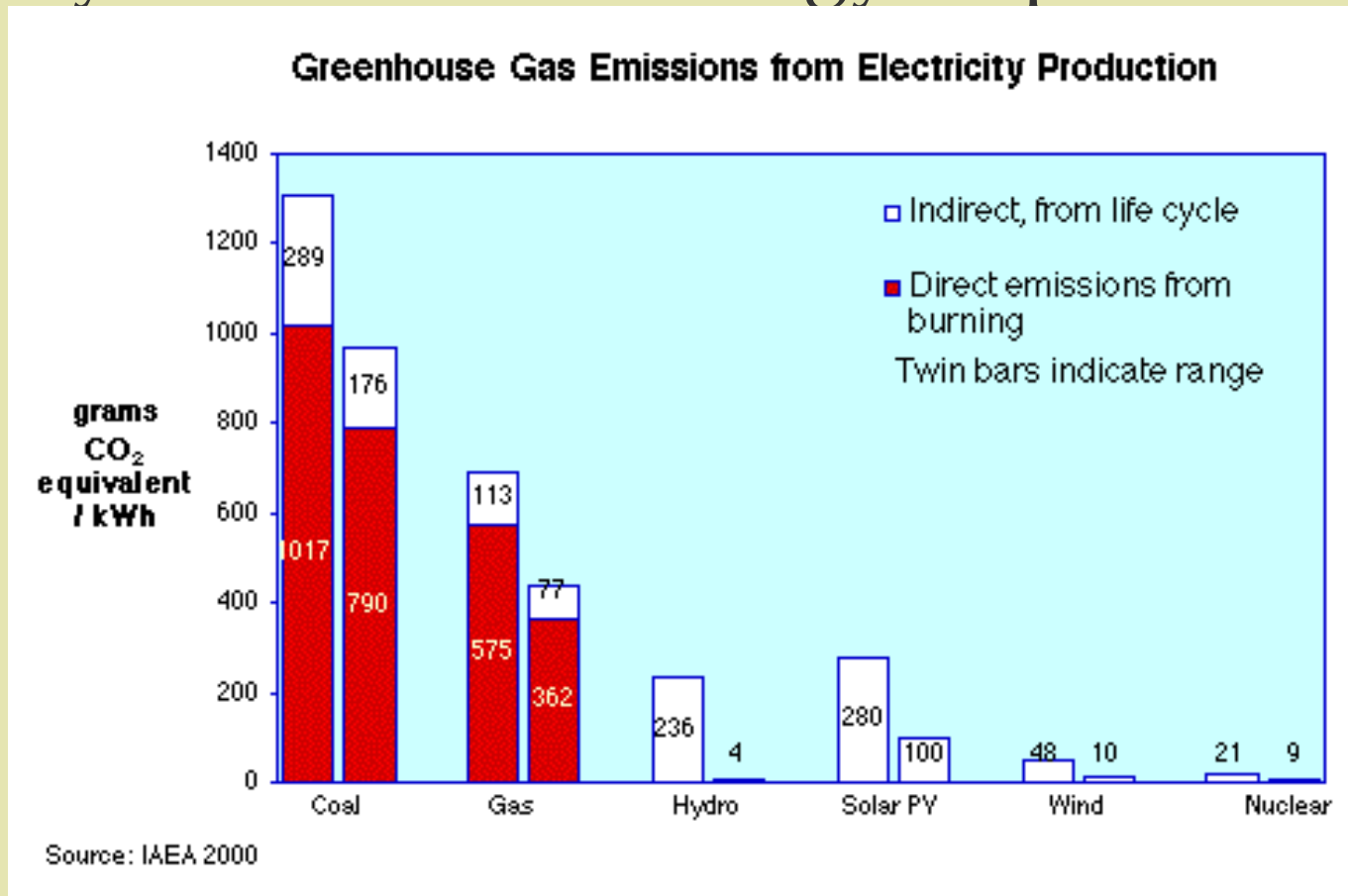
# Generation, Share up Strongly to Late 1990s, but Now Declining



# Why No New Plant Since 1995?

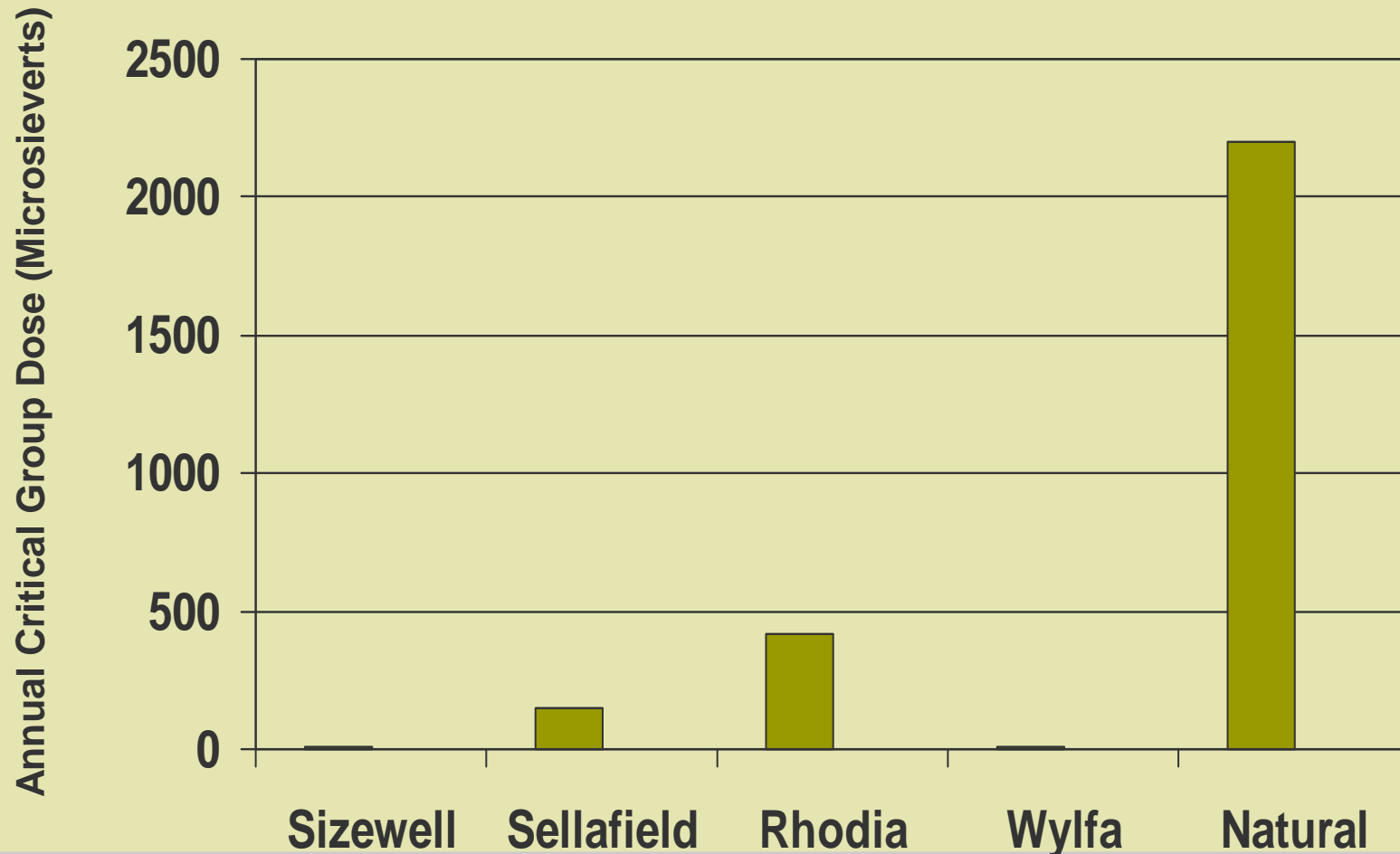
- Liberalisation of electricity industry from the 1980s
  - greater uncertainty in price levels and base load requirements
  - uncertainty about waste management and decommissioning costs, and who would pay for them
- High efficiency gas CCGT plant became available
  - coupled with ready supplies of relatively cheap gas
- Reprocessing used fuel adds cost
  - at approximately 0.45 p/kWh electricity generated
- Electricity generation capacity surplus in the UK
  - Prices fell in 1990s
- Public perceptions of safety – especially post-Chernobyl

# Lifecycle Carbon & Energy Impacts Low

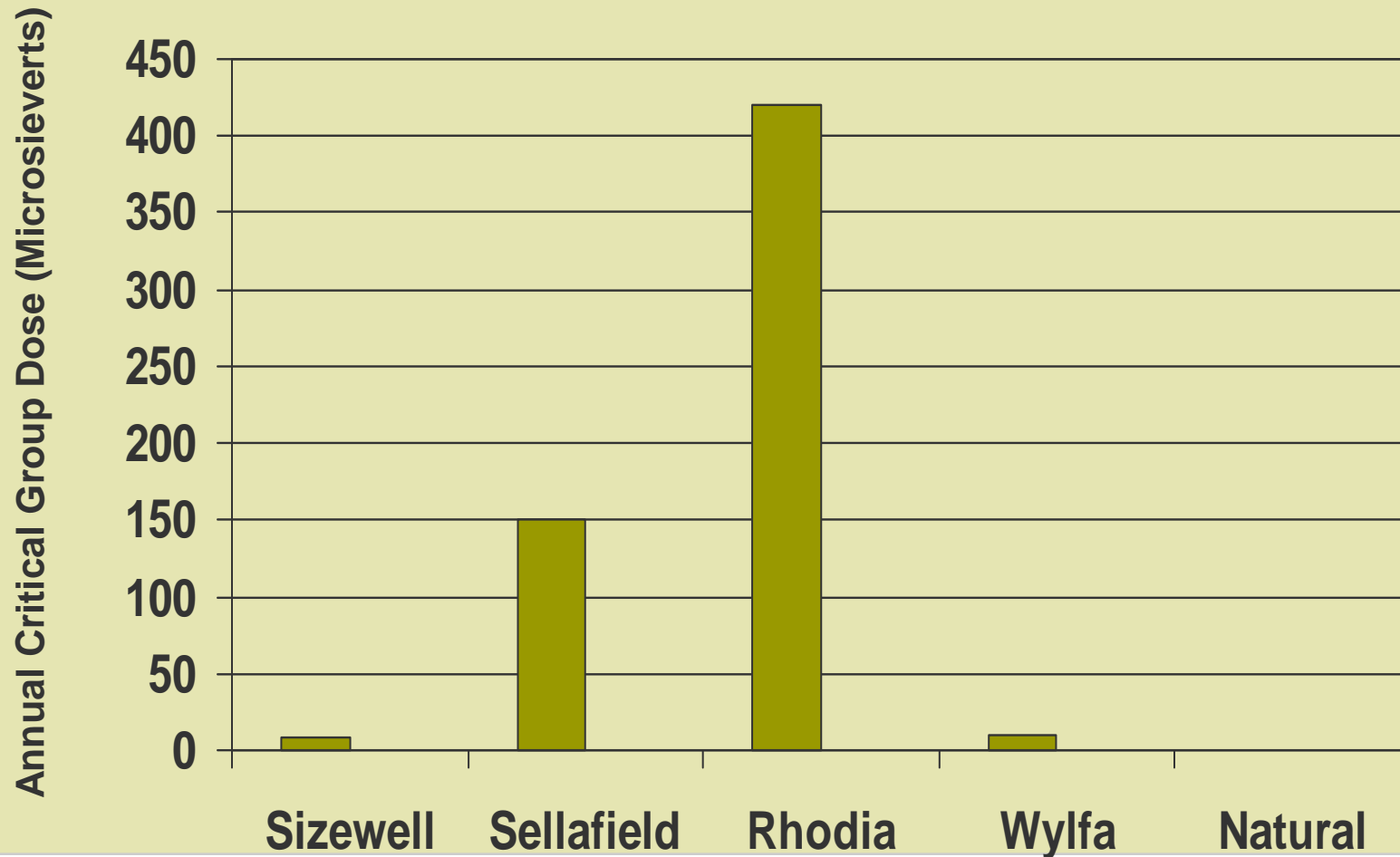


A PWR reaches energy break even point after around one year of operation

# Radioactive Releases from Normal PWR Operation Compared to Other Sources



# Radioactive Releases from Normal PWR Operation Compared to Other Sources



# How UK Decides to Deal with Stocks of Plutonium and Uranium is Important

- **Are they assets or liabilities?**
  - Depend on prices on world markets, viewpoint
- **Is there a need to move away from current Plutonium powder form to something passively safe?**
  - If yes, generation using MOX could be part of the solution
    - 2 new reactors could use up all UK's civil Pu stocks
      - » Logically sited at Sellafield – where the Pu and the fuel plant is
      - » major socio-economic benefits to Sellafield, North West, UK



# Nuclear Reactor Attributes

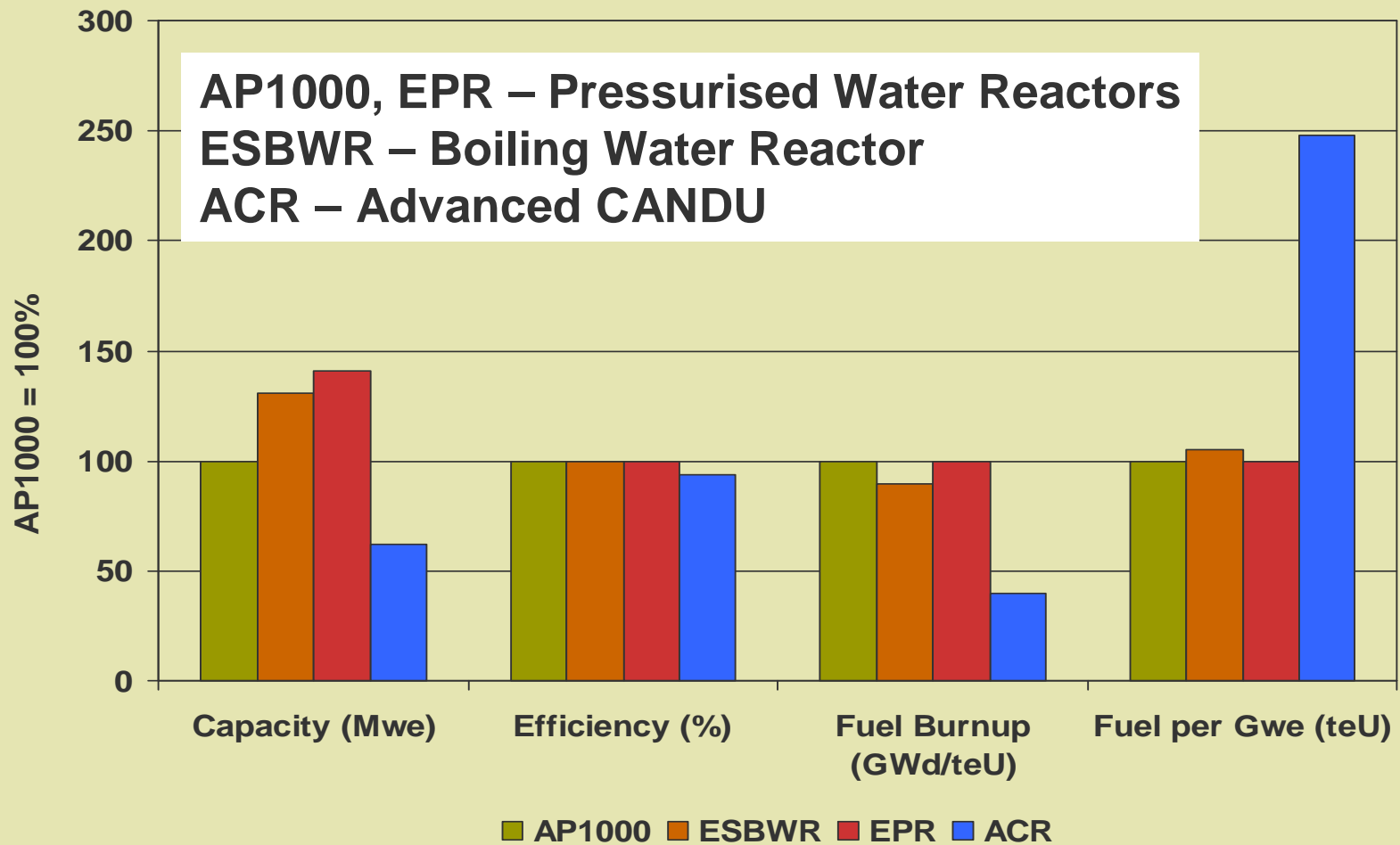
# Reactors in the UK – Experience to date

- **Generation I Magnox: 10 stations – 9 different designs (plus another two exported!)**
- **Generation 2a AGR: 7 stations – 4 designs, 3 design and construction consortia**
- **Generation 2b PWR: 1 station, derived from US design but extensively modified – ends as very much a ‘one of a kind’**

## **Comment:**

- ***18 reactors, 14 designs***
- ***only the near-identical Heysham 2 and Torness stations were built in parallel, and this proved very beneficial in minimising delays and improving construction efficiency***

# Reactors for the UK? – What's Available Now



***All much of a muchness – except Candu (ACR) which is a very different concept***

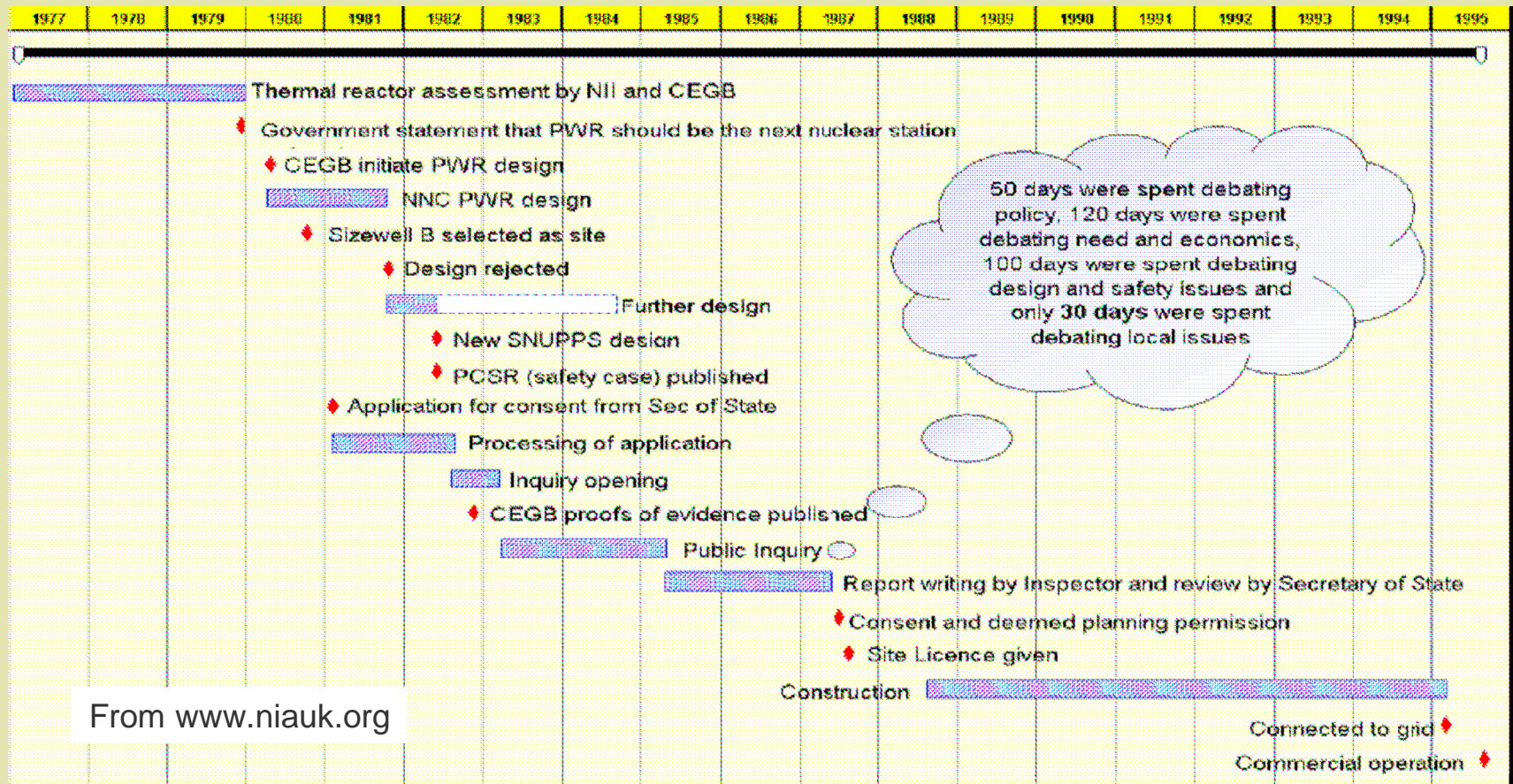


# Policy, Legislation and Regulation

# Current Policy Supports Renewables but No Other Technologies

- **Renewables only receivers of financial support**
  - meeting current renewables targets challenging
  - also support for energy efficiency and CHP
- **No general support available for carbon benefits, and none for security of supply**
- **General consensus is nuclear new build only viable if Government has “supportive” policy stating need**
- **State support for nuclear in a competitive market could be difficult**

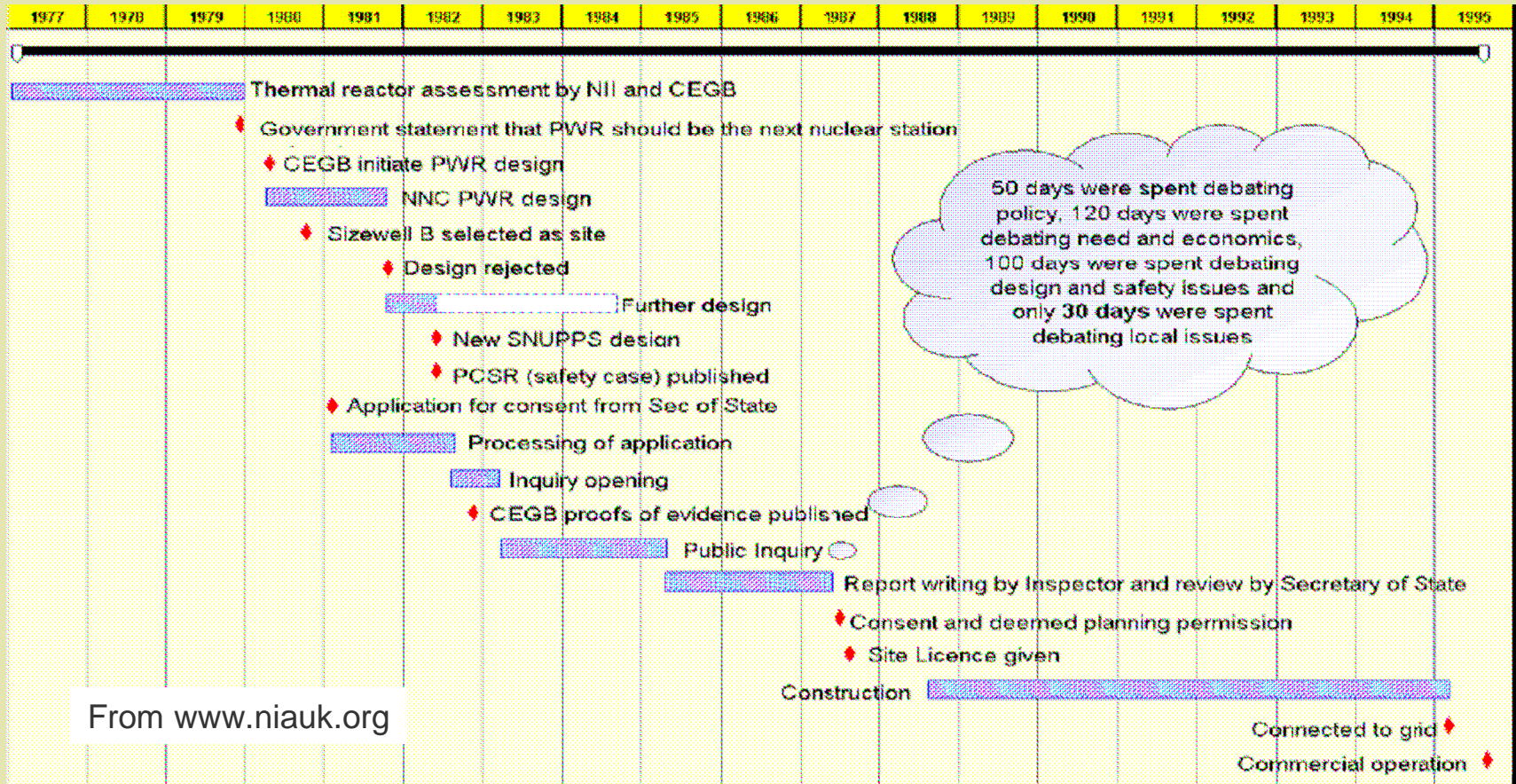
# Licensing and Regulation – Sizewell B Took 14 Years to Plan and Build



From [www.niauk.org](http://www.niauk.org)

**Sizewell B experience - 7 years from site selection to site license**  
**- Construction 6.5 years**

# Any risk of a repetition = 'no chance' for new build!



**Sizewell B experience - 7 years from site selection to site license  
- Construction 6.5 years**



# Electricity Transmission

- **Grid reinforcement would be needed for any plant in north of Britain**
- **In particular, Sellafield is:**
  - far from grid
  - far from South, where most demand is
- **Same constraints apply to renewables**
- **Not an absolute constraint**
  - more a matter of cost – for Sellafield about £70 (1 reactor) to £230 million (2 reactors)



# Obtaining Consents and Connection Costs are Key Sellafield Issues

- **Two possible routes:**
  - Southern route (to Hutton near Kendal) passes next to Lake District National Park
    - unlikely to get planning permission consents
  - 80 km northern route (to Harker near Carlisle)
    - would still have consent problems
- **Value of a ‘volunteer’ site of a similar order to extra connection costs**



# Sellafield: Siting and Economics

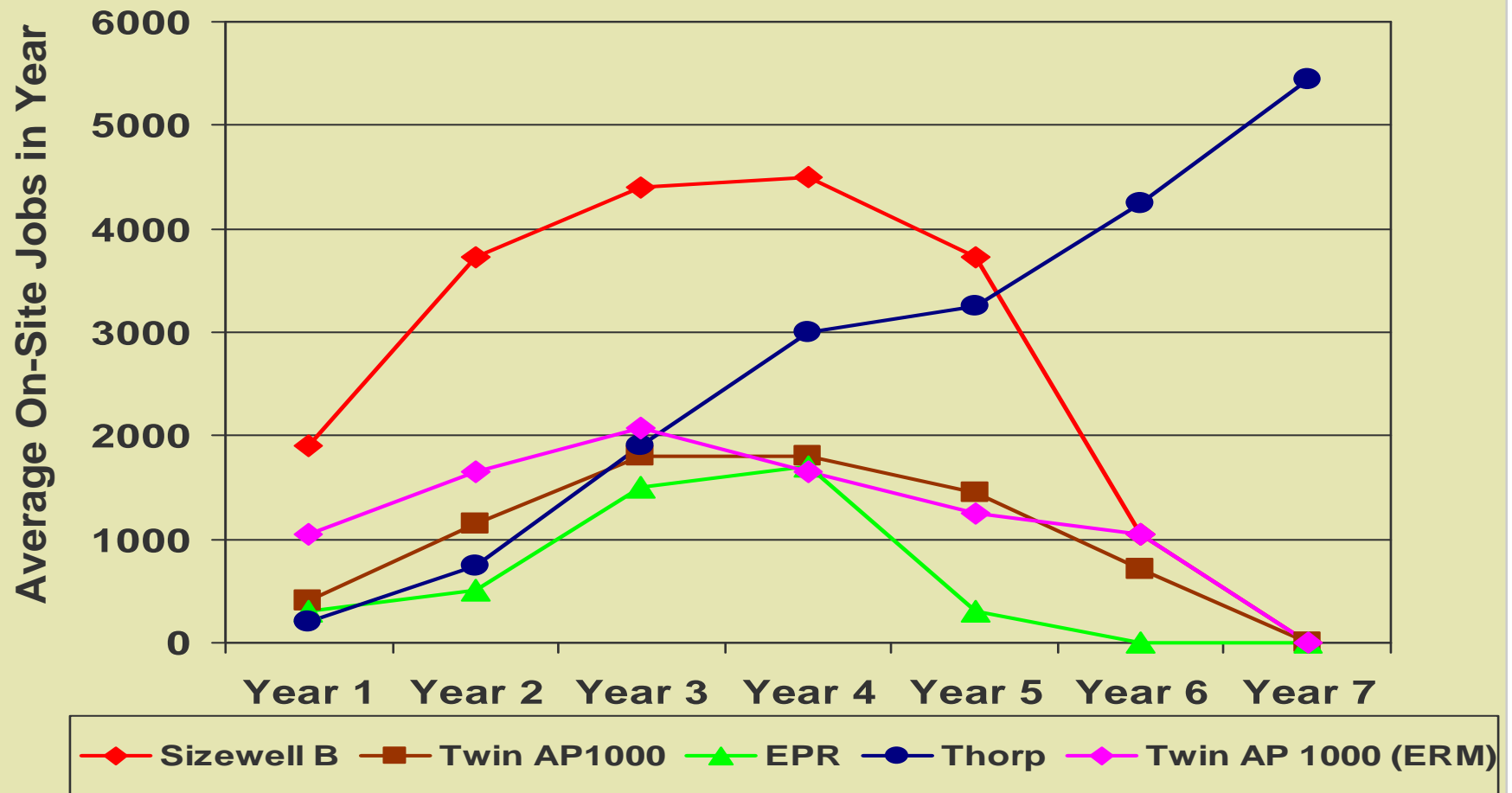
# Sellafield – Setting the Scene

- **Established 1947 – plutonium production for weapons**
- **Calder Hall opened 1956, closed 2005**
- **Windscale Piles closed after fire in 1957**
- **Magnox reprocessing from 1956 – due to finish in 2012**
- **Thorp – operations 1995 to around 2011?**
- **NDA ownership 2005 – cleanup main mission**
- **Sellafield Mox Plant – still commissioning**

## Available Reactors - Analysis

- **Reactors all 'sold' on short construction – 4 years or less (but none currently in production)**
- **Cost about £2 to £3 billion for a twin station**
  - 60% could be captured by UK supply chain
- **Construction effort (twin AP1000) one third of Thorp**
  - Peak on-site workforce about 2,000 (mostly local)
  - Total = 7,000 to 9,000 person years of employment
  - 600 permanent jobs for 60 years
- **Following illustration assumes: policy decision 2007, construction start on site 2010, first generation 2016**

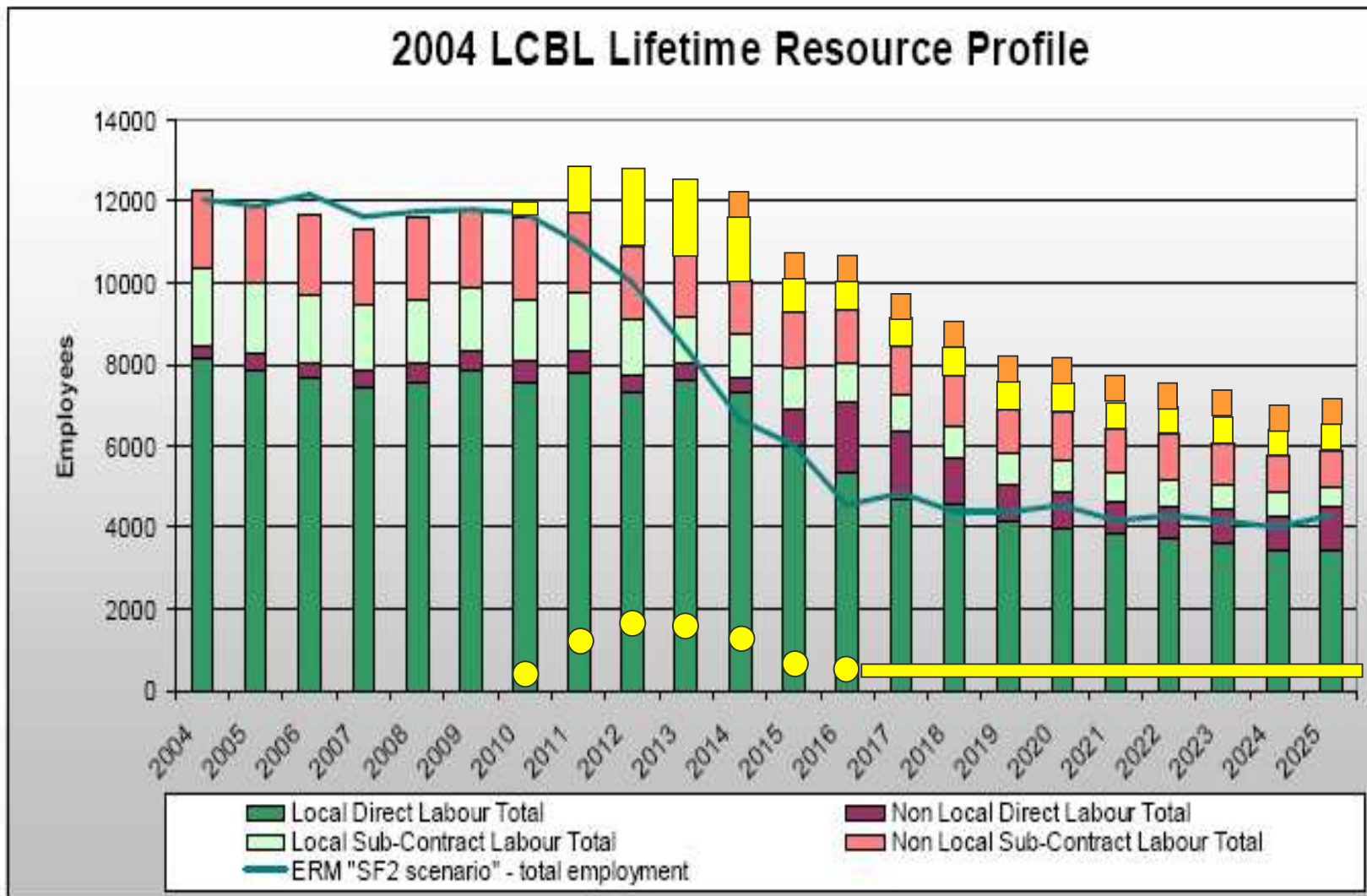
# Reactor Projects - Analysis



# Issues for Siting at Sellafield

- **Technically viable site – extensive study in 1988-1994**
- **Not optimal, but in top 5 of existing licensed sites**
  - grid connection was major issue
  - value of ‘volunteer’ site could mitigate connection costs
- **New reactor at Sellafield could burn Plutonium stock**
  - minimises plutonium movements
  - gives ongoing employment in SMP (or its successor) until around 2050
- **Fits with National Nuclear Laboratory, Skills Development agendas in West Cumbria**

## 2004 LCBL Lifetime Resource Profile



● 2xAP1000  
(Reference: BNFL Energy Unit)

■ Ongoing Mox Manufacture

# Summary

- **The retirement of old coal and nuclear power plant is creating a large need for new generating capacity in the UK**
  - renewables and energy efficiency will fill only part of this gap
- **Until recently assumed that gas would fill most of this gap...**
  - ...however, price rises and security of supply concerns have led to this assumption being questioned
- **With current technologies, it is unlikely that future power needs will be met without breaching carbon emissions limits**
  - hence the 2006 Energy Review, including nuclear

# Summary

- **UK could capture 60% of £2-3B cost**
- **NW slice could be large (existing nuclear cluster)?**
- **Sellafield is a viable site for nuclear new build, although not an optimal one**
- **New build at Sellafield could create about**
  - 7,000 person years of construction employment
  - 600 to 1,000 permanent jobs
  - supply chain benefits
  - fit with nuclear skills and technology strategies for West Cumbria



# **North West Energy Forum**

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**Ron Cockayne**

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# The Northwest Centre for Waste Management Project

# The NW CWM project will facilitate:

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- Networking opportunities
- Knowledge dissemination activities
- Access to relevant case study material
- Access to facilities and academics within NW based universities
- Maintenance of a web portal
- Development of an Environment4Business website for NW business

# The NW CWM will provide:

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- Access to Advisors
- Access to information on other projects
- Assistance in the development and implementation of EMS and Environmental policies
- Specialist environmental/waste audits
- Support in the implementation of action plan
- Provision of dedicated storage system for important environmental documents
- Advice in identifying, planning and funding longer term research and development projects

# Location of NW CWM and Partners:

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- Financial and human resource in developing R&D projects
- Support in identifying other sources of funding for R&D projects
- Development and delivery of support programmes
- Development and delivery of an innovative piece of software supporting
- Project delivered by the University of Central Lancashire
- Fully eligible objective 2 businesses

# Project Objectives:

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- Enhance environmental performance
- Significantly increase the capacity for innovation
- Encourage and implement R&D
- Stimulating entrepreneurship
- Assisting innovation and the development of new and improved products
- Providing graduate placement
- Developing clusters and networks of SMEs
- Developing opportunities for business



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**Close**