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Research Needs for a Low Carbon Energy Future

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Managing Director, E.ON Engineering

University of Nottingham, 16 September 2008

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Outline of Presentation

Global Warming

The Energy 'Trilemma'

World Energy Trends and Implications

UK Specific Issues

Low Carbon Options and Cost Considerations

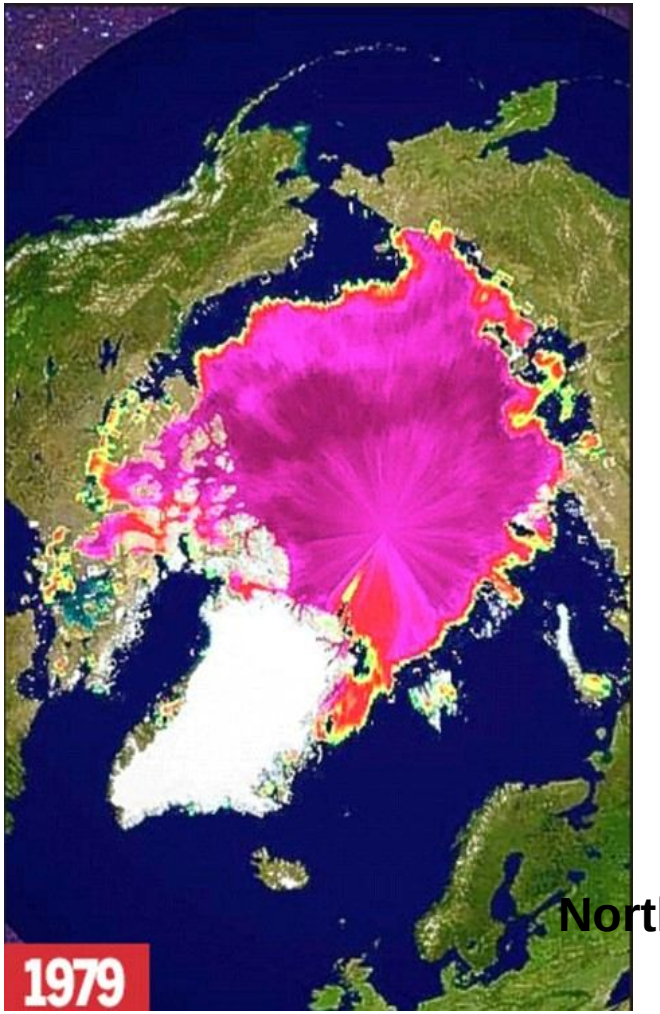
R&D Needs and Delivery Options

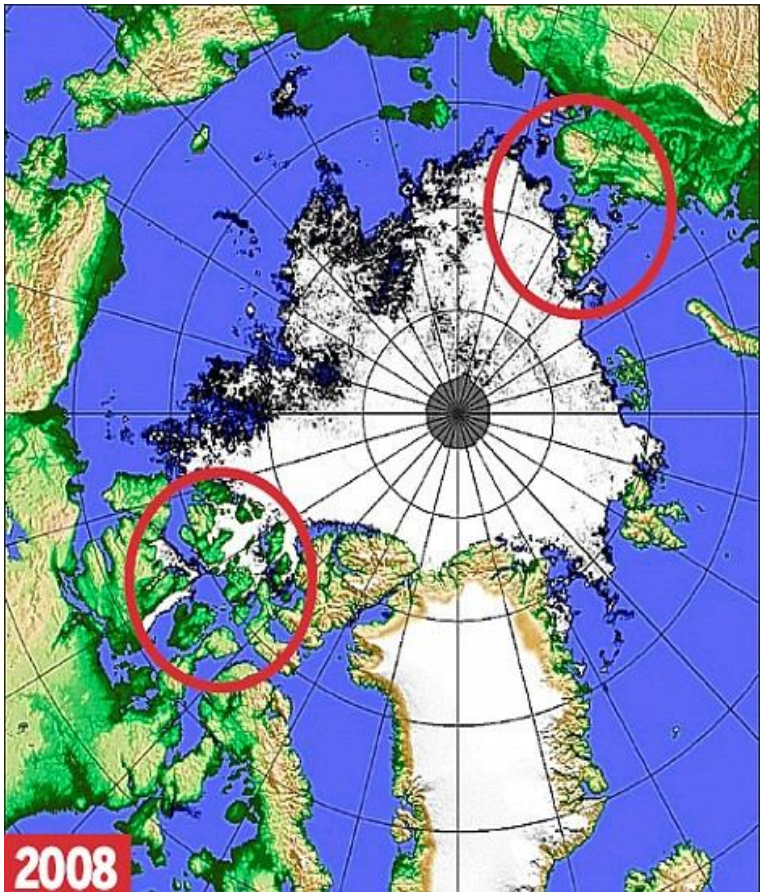
Summary and Conclusions

Extreme Weather Events

Recent Floods in Tewkesbury

Global Warming?





North Pole an ‘island’ for the first time in human histor

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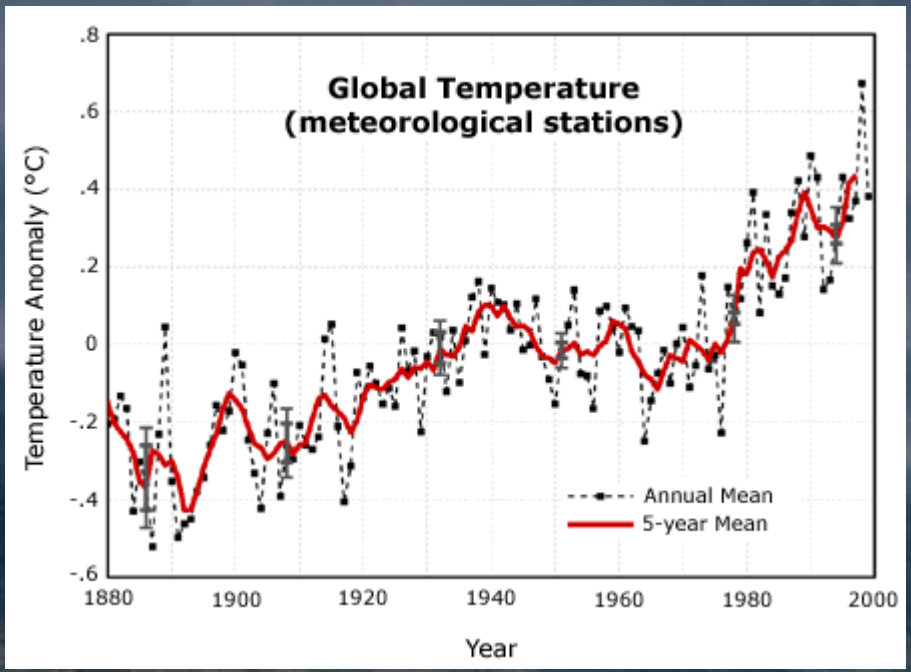
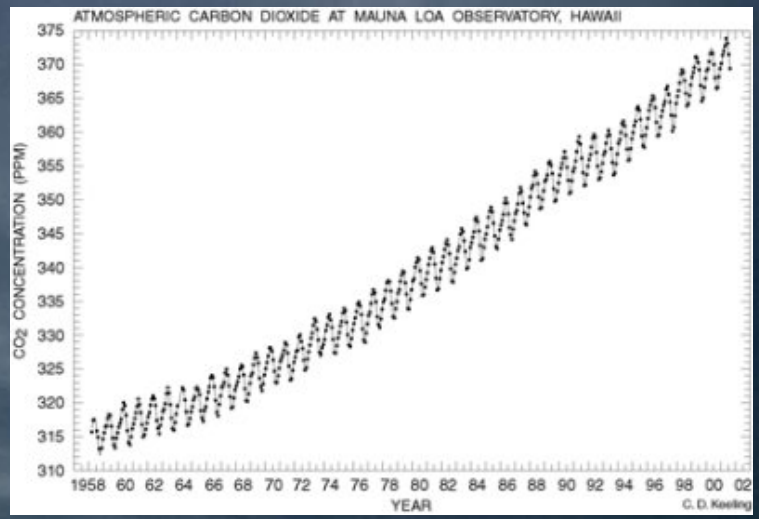
CO2 – What is the





2005 –
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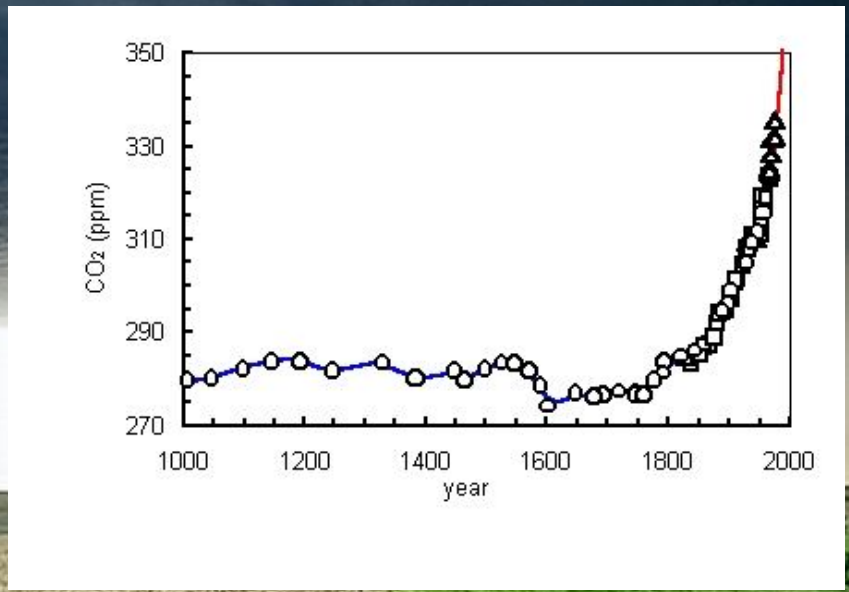
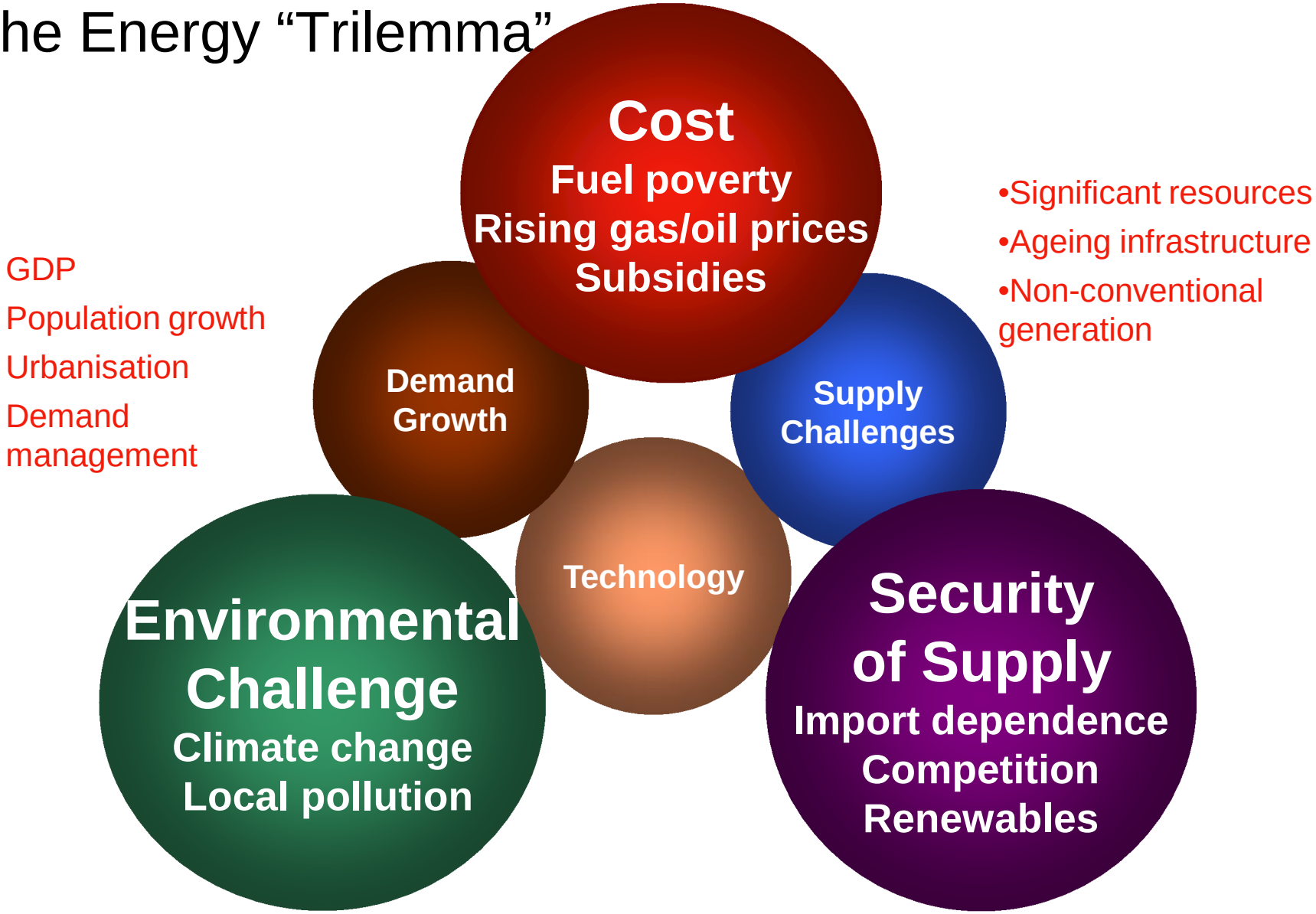


Global Warming is a Fact……

….and atmospheric levels of CO2 are increasing

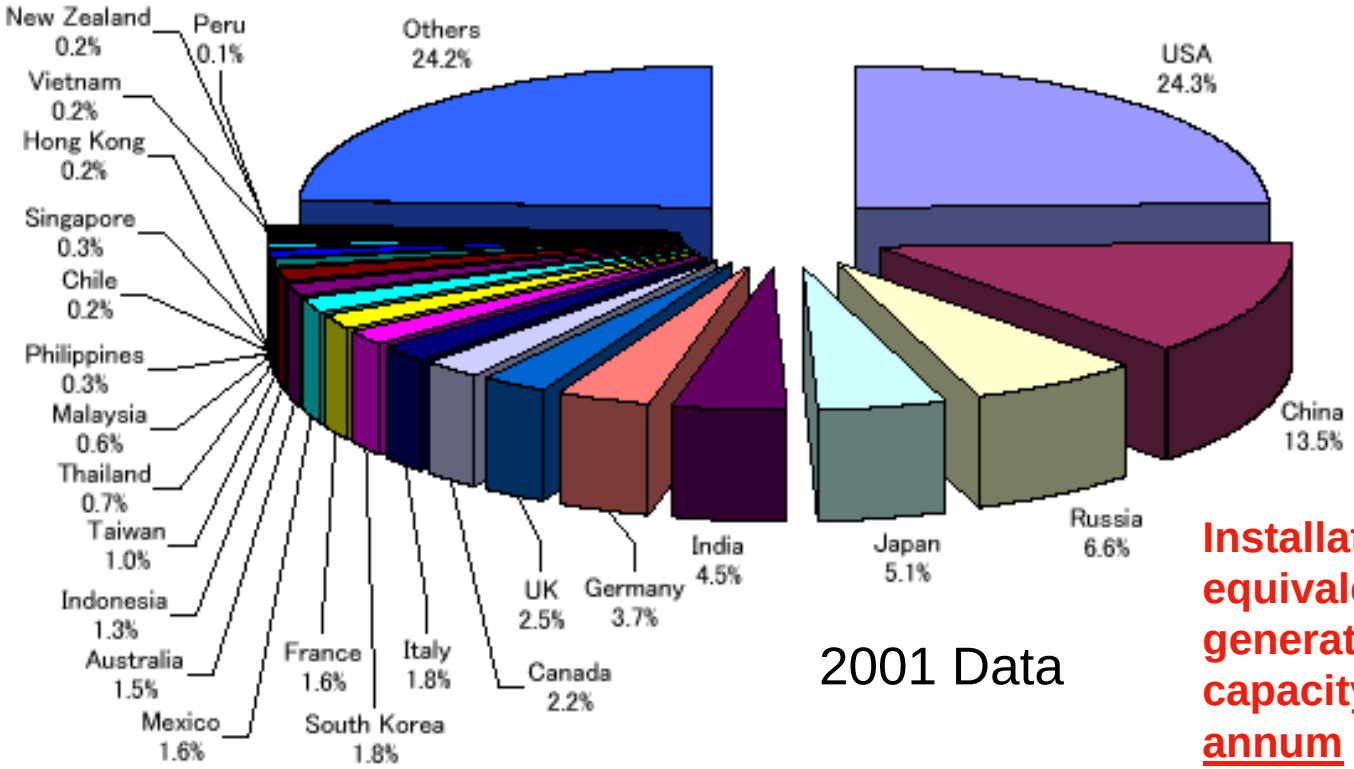
The Energy "Trilemma"



GDP
Population growth
Urbanisation
Demand management

•Significant resources
•Ageing infrastructure
•Non-conventional generation

Emissions of CO_2 by Country



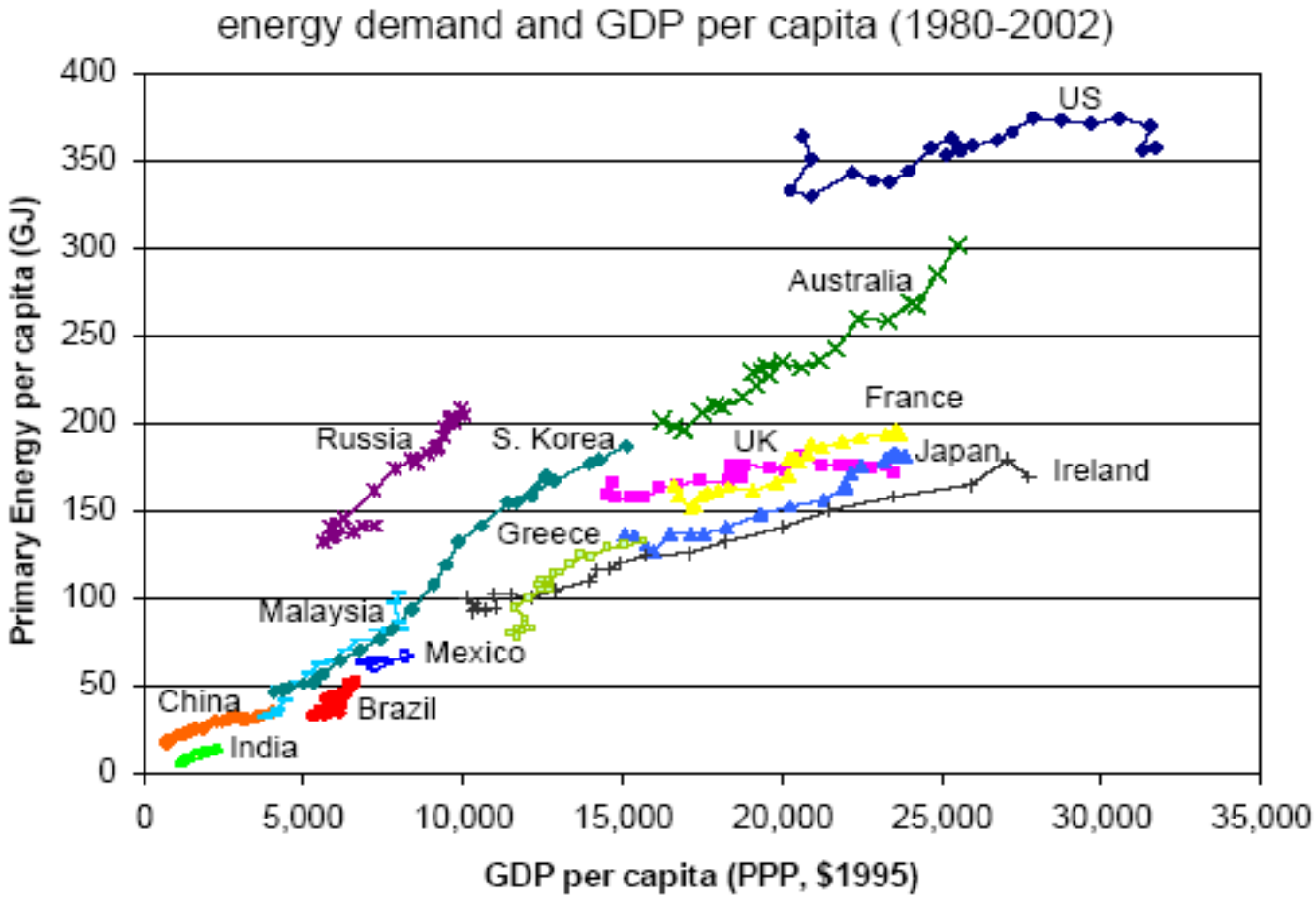
2001 Data

Installation of equivalent of UK generating capacity <u>per annum</u>

In the UK, about 30% of CO_2 emissions come from power generati

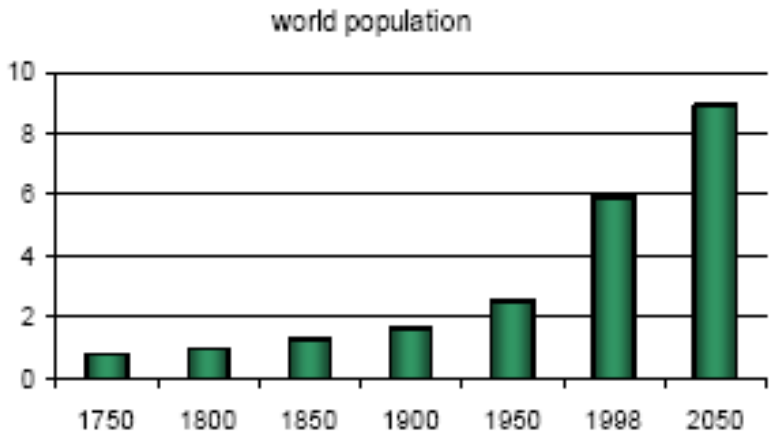
…and modern gas fired power stations emit about half the CO2 from coal s

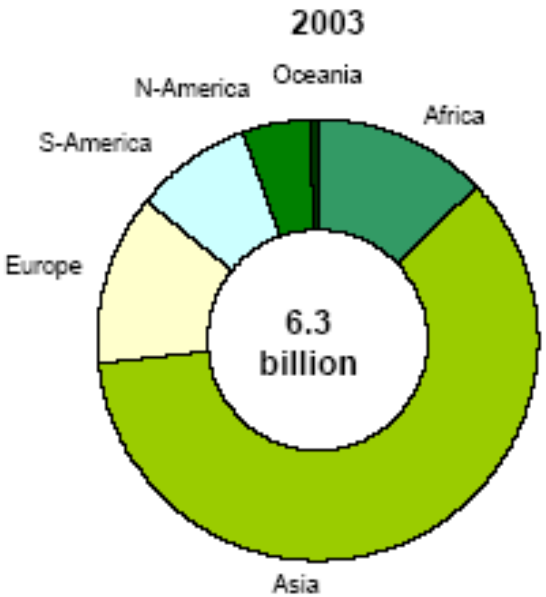
Environmental Challenge – world economic development

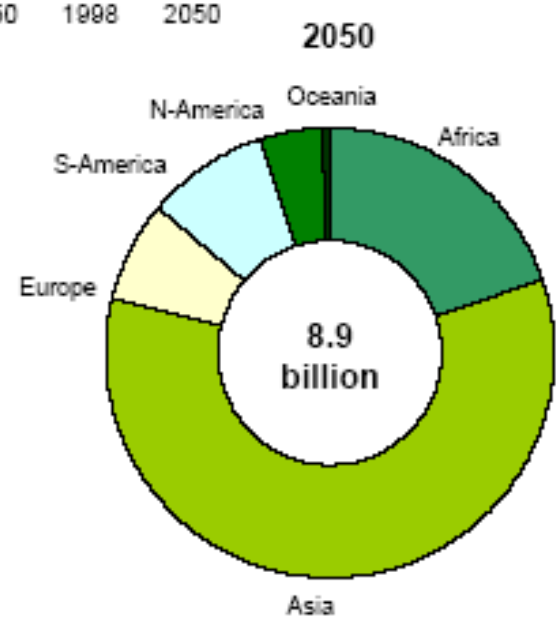


Source: UN and DOE EIA

Environmental Challenge – world population increase

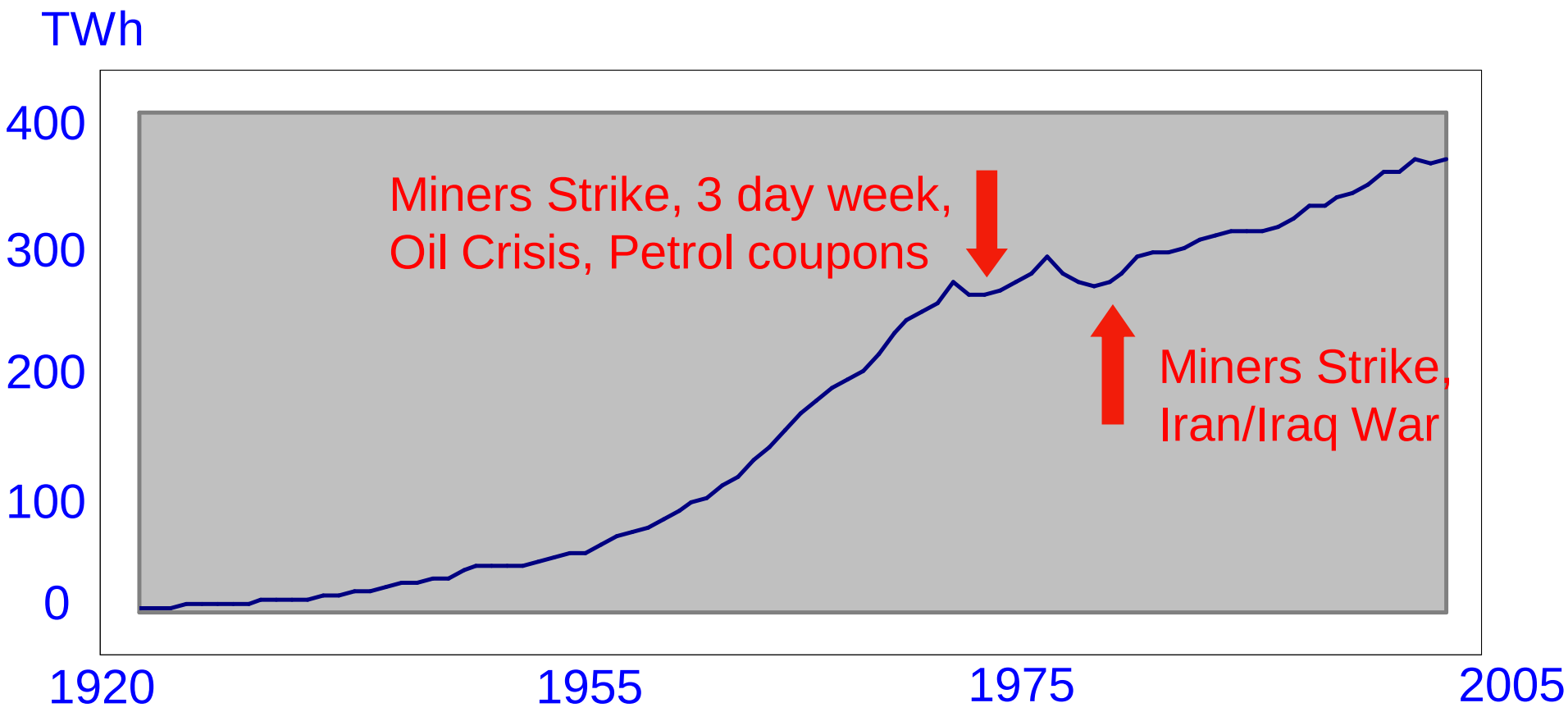




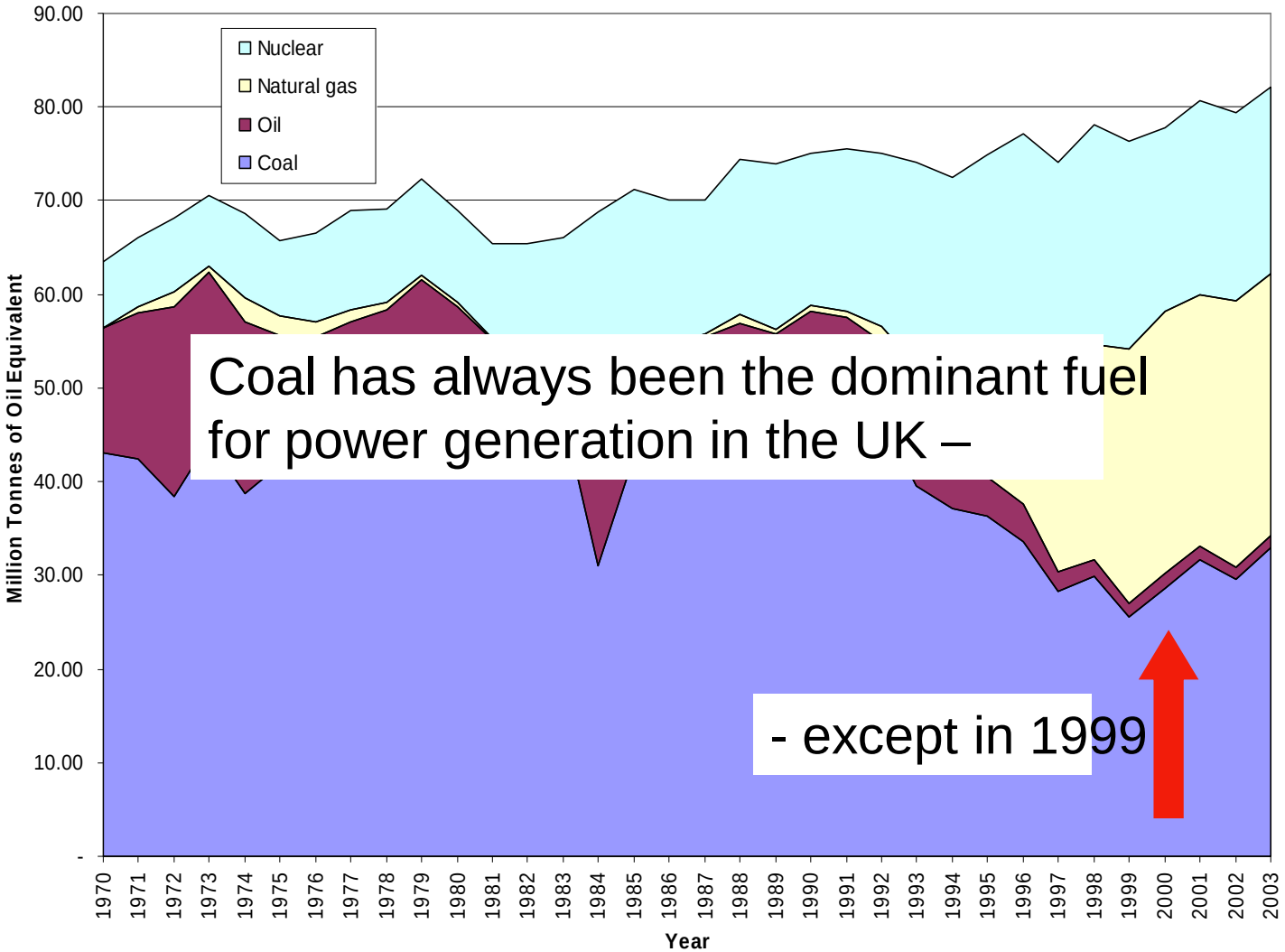


source: United Nations

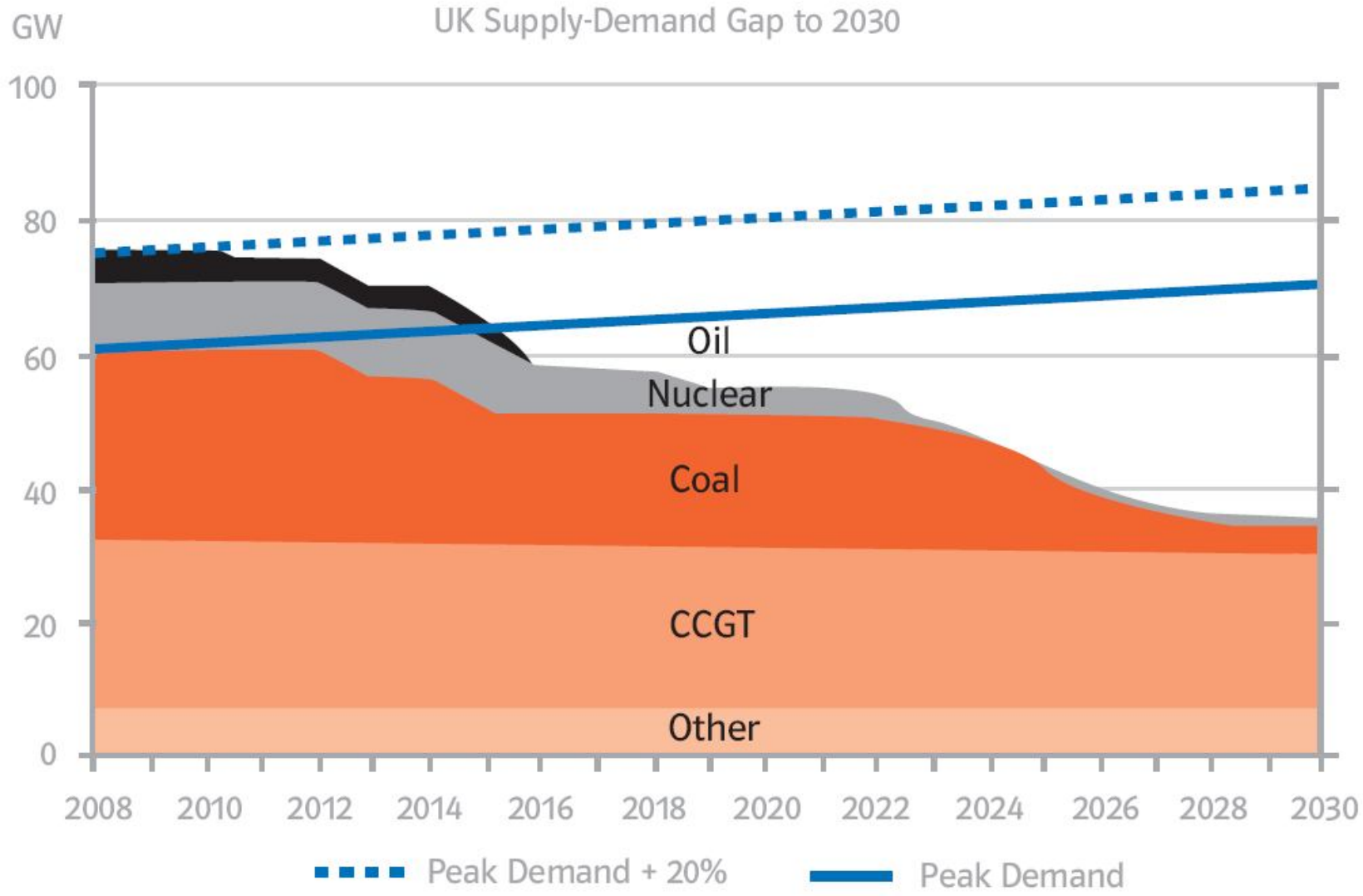
Electricity Generated in the UK 1920 -2005



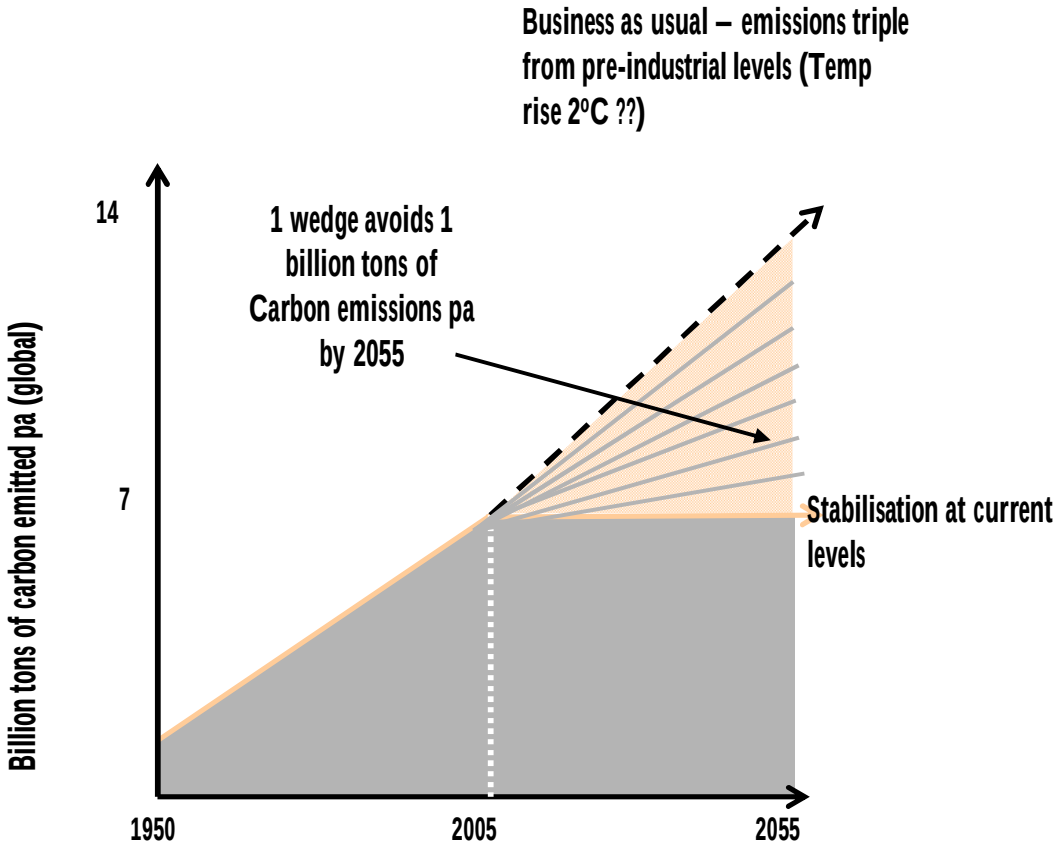
Fuel Input for UK Electricity Generation, 1970 to 2003



Security of Supply – the capacity gap



Schematic of range of actions required globally



One "wedge is equivalent to any one of the following:

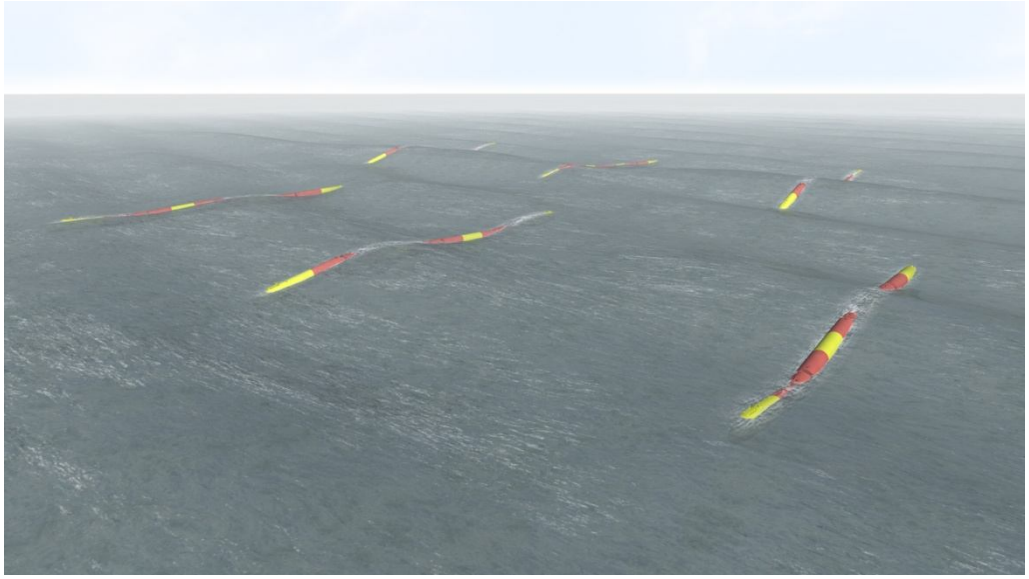
- A global shift from coal to gas
- Wide scale carbon capture and storage.
- Major investment in nuclear
- Increased use of renewables
- Wide scale adoption of small scale combined heat & power or fuel cells
- Energy efficiency measures.
- Transport – doubling fuel economy or halving the

Source: R. Socolow et al, "Solving The Climate Problem," Environment, Volume 46, December 2004, 8-19.

E.ON Off-shore Renewables

Offshore windfarms –
Scroby Sands – 60MW

Pelamis wave energy device –
proposed 5MW demonstration off Scottish coast



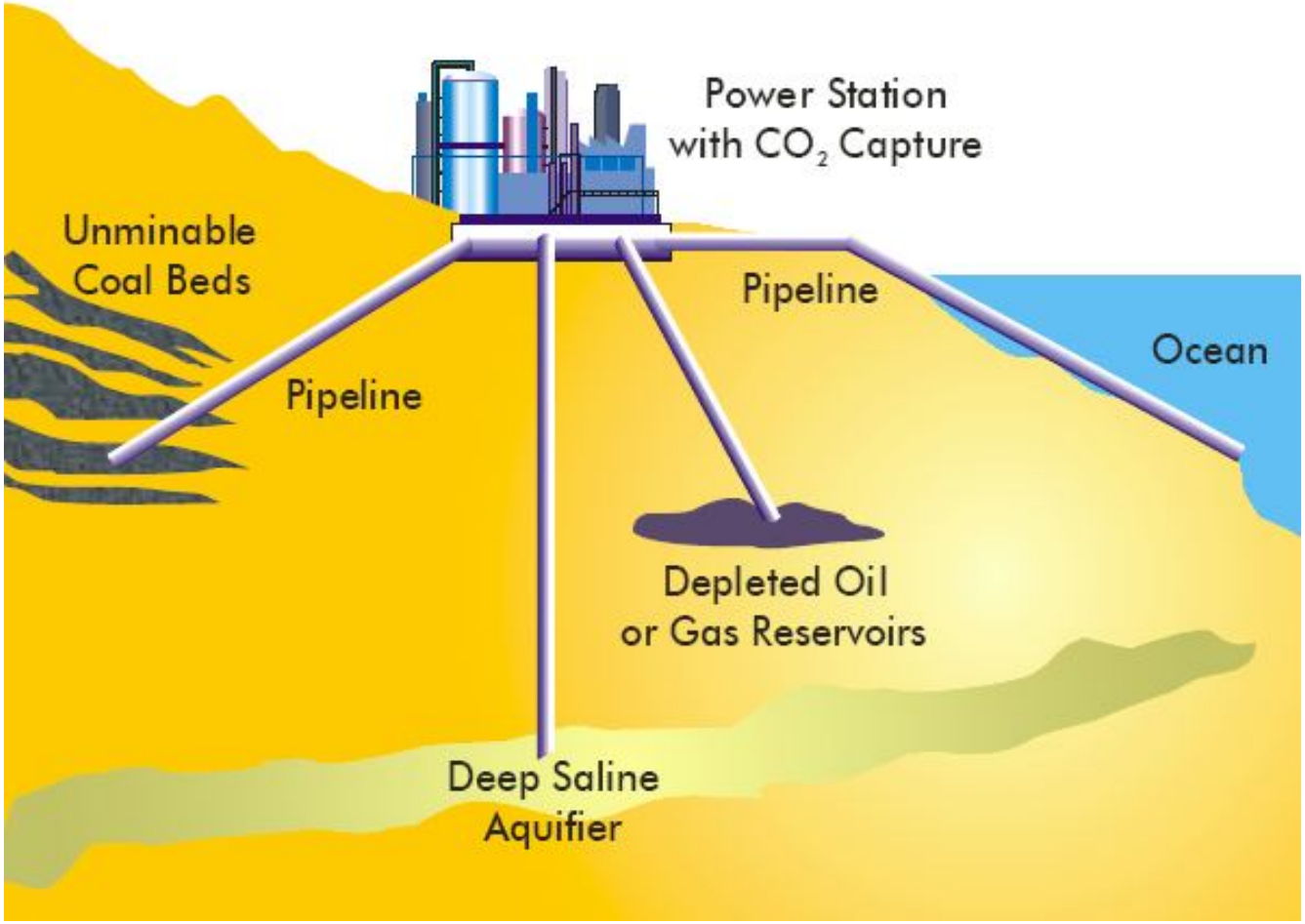
Carbon Storage – How?

Transport as a liquid via pipeline

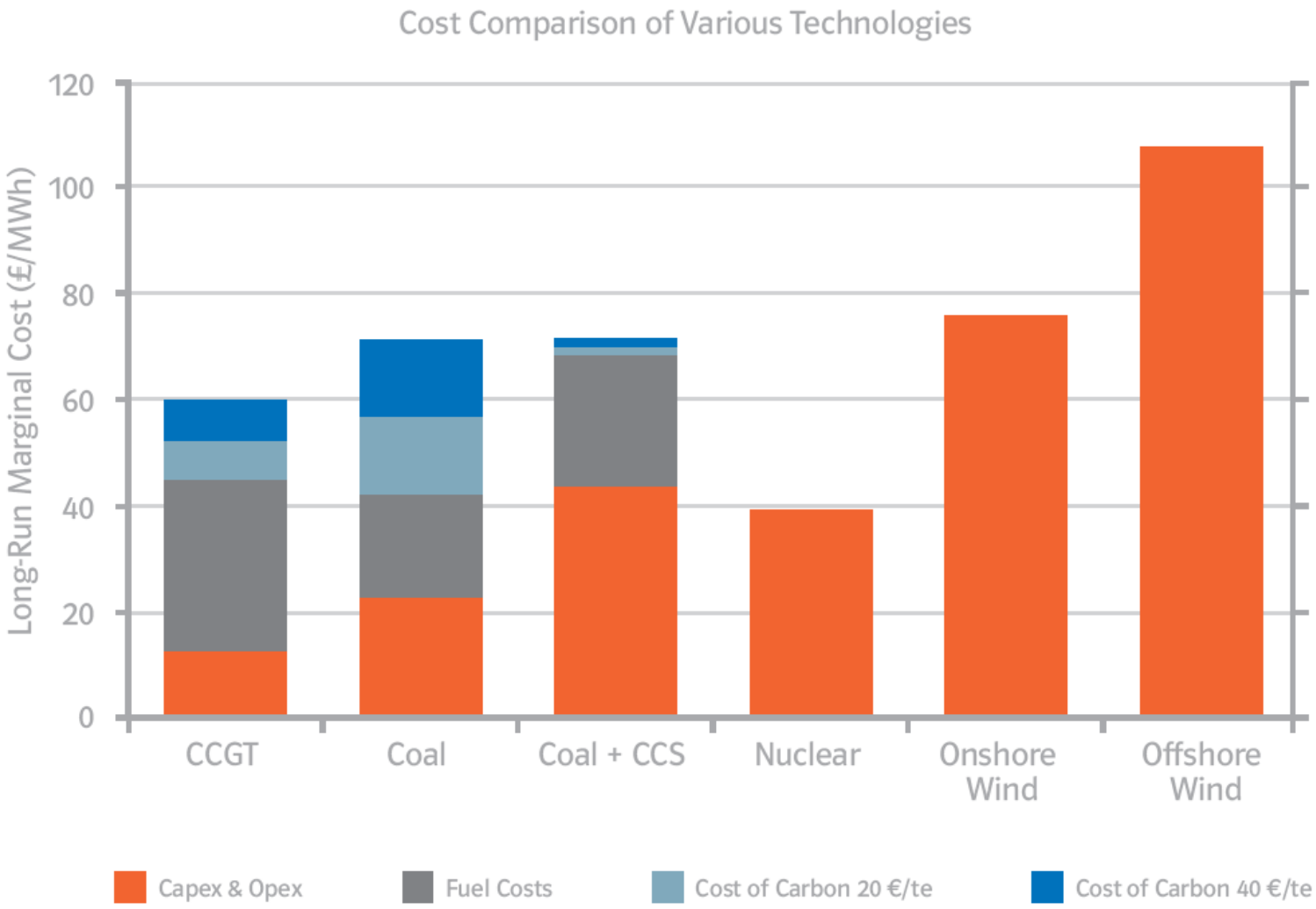
A number of storage options include,

- **Coal beds**
- **Saline Aquifer**
- **Depleted Oil/Gas reservoirs**
- **Ocean ?**

As with other options concerns are not simply technical: Political, Economic, Social, Legal, Environmental



Energy technology cost comparison



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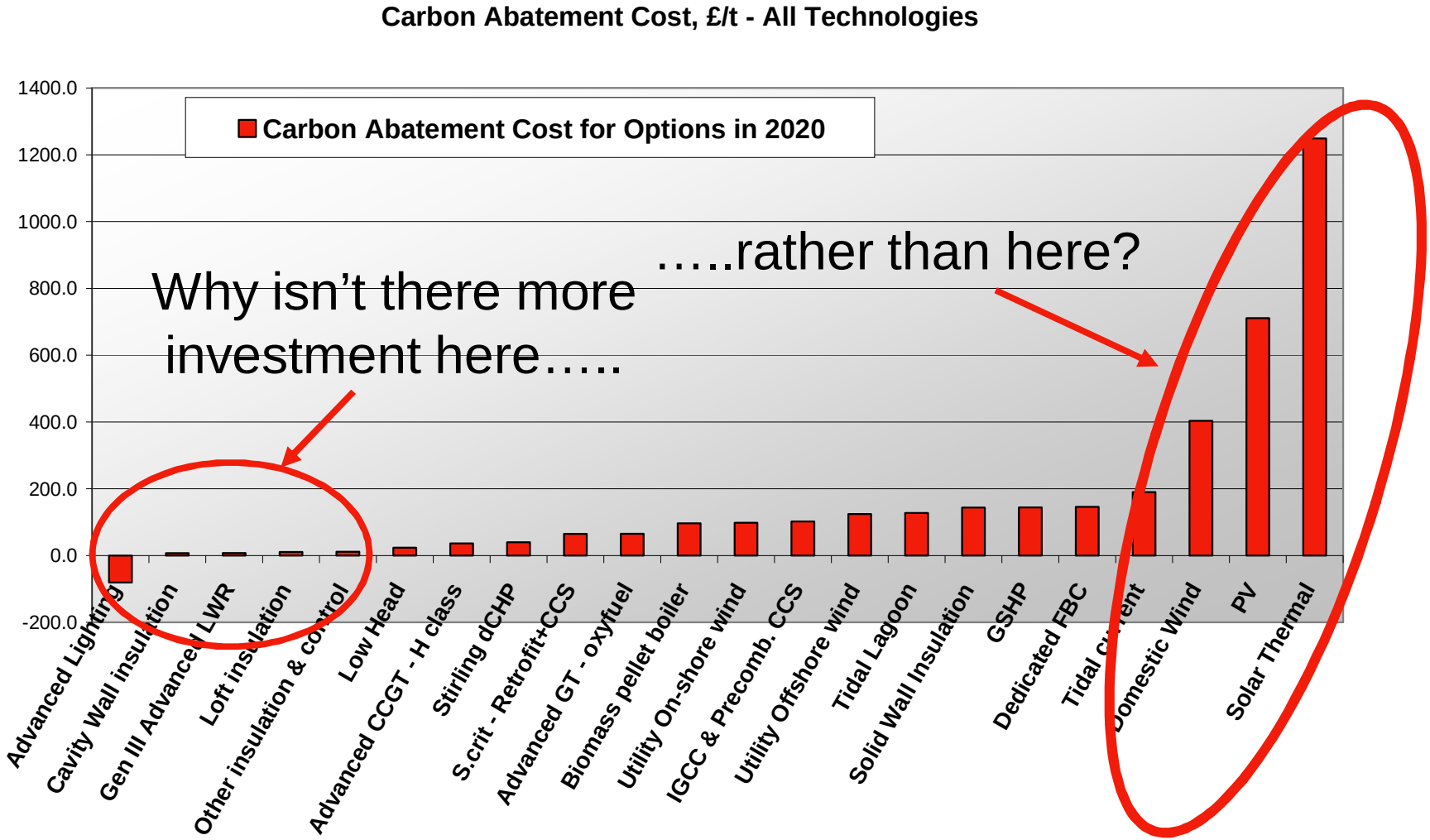
Carbon abatement technology – why are some of the most expensive technologies attractive?



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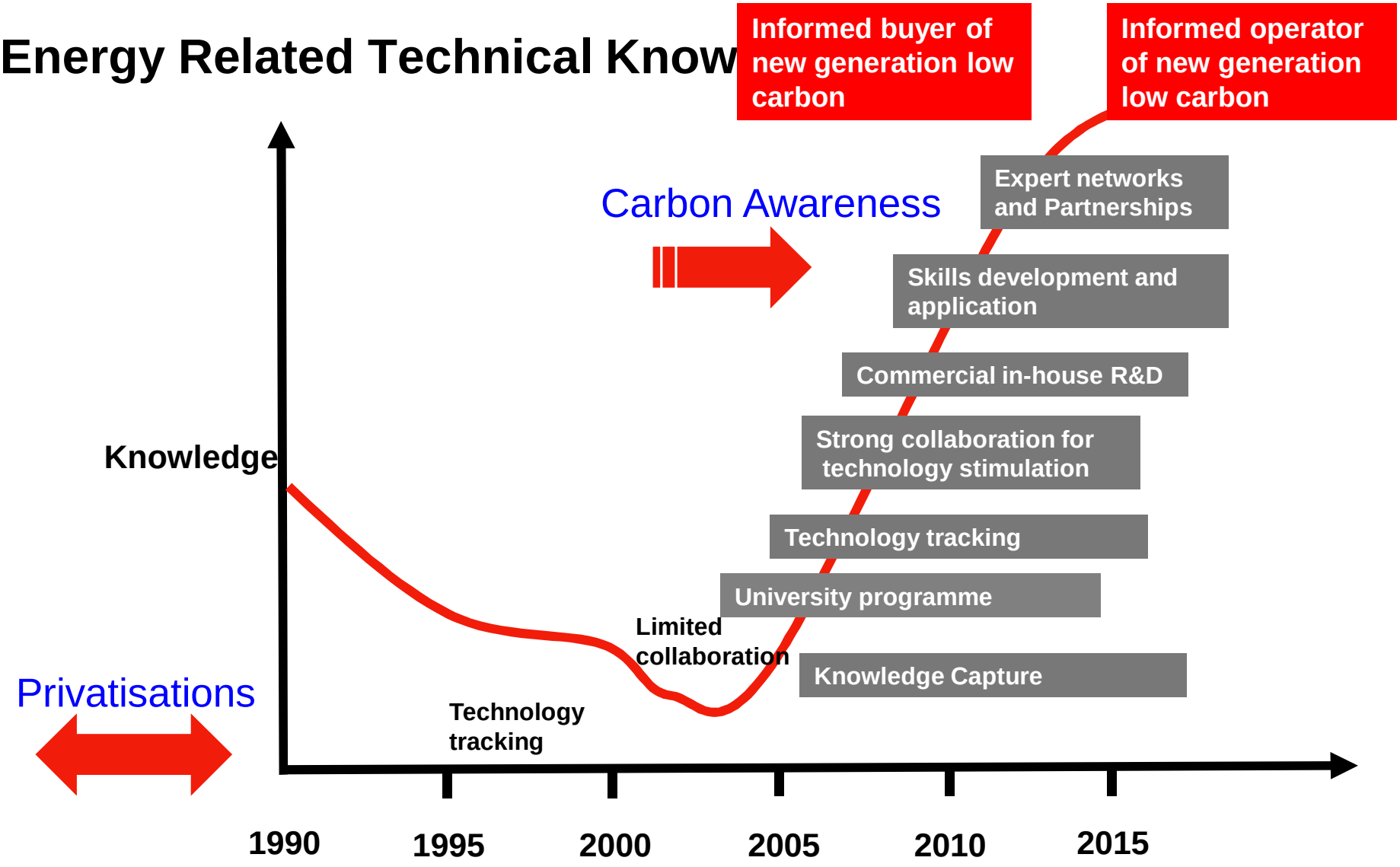
Energy Related Technical Know



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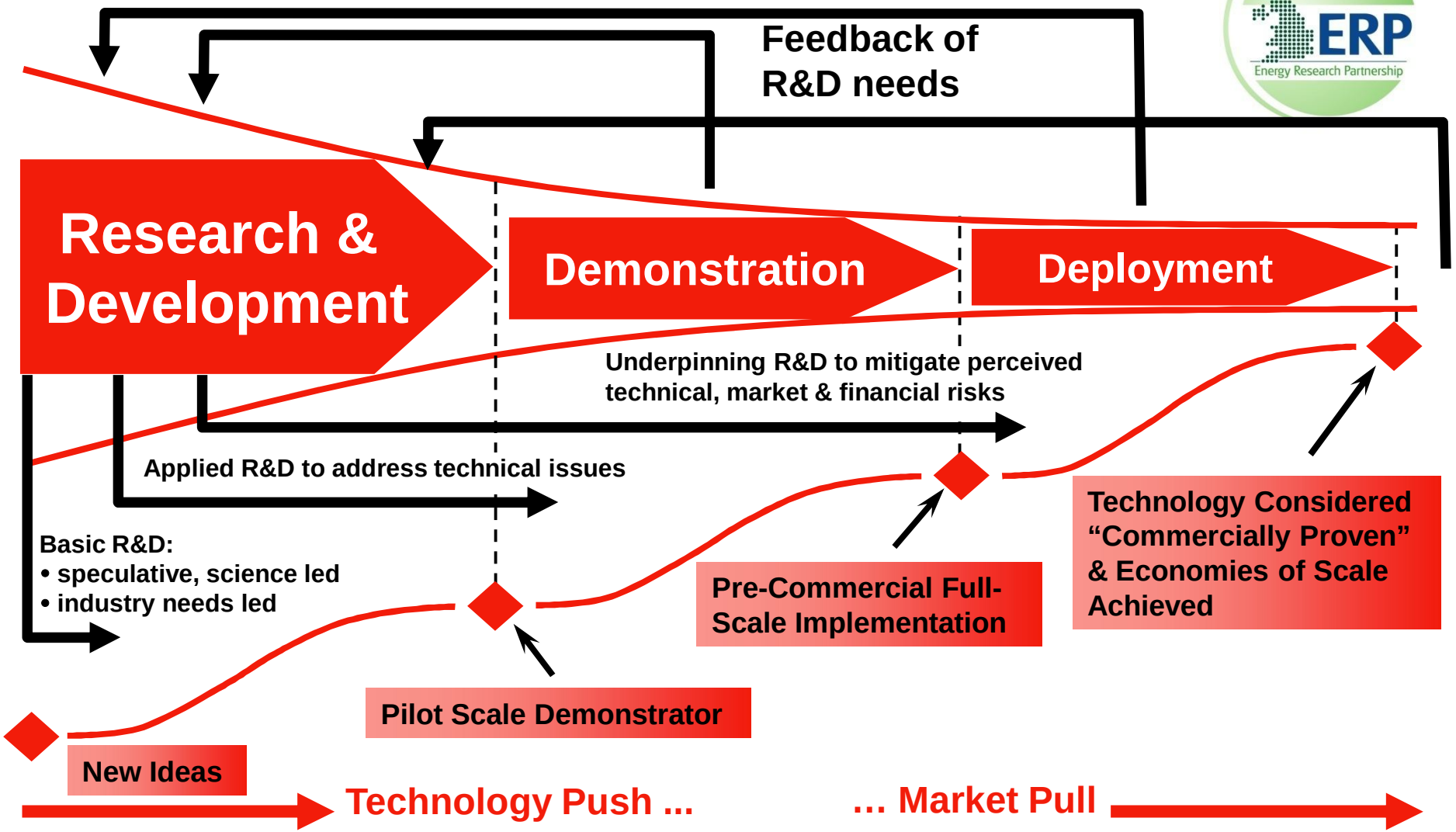
Model of Energy Innovation Lifecycle



Energy Technology Institute

- Concept launched by the Chancellor in 2006 Budget
- 50/50 Public/Private partnership providing up to £1.1Bn over 10 years
- HQ Hosted by the Midlands University Consortium at Loughborough

Themes:

Large Energy Supply (inc CCS)

- Security of Supply
- Demand Management
- Transport
- Small Scale Supply
- Infrastructure
- Energy Poverty

Project size:

- Typical projects expected to be £5-25m
- Potential for ETI to fund 100% of project costs

Status of ETI Technology Programmes

Programme Area	Status
Offshore Wind	Commissioning
Marine	Commissioning
Distributed Energy	Commissioning
Networks & Storage	Programme Scoping
CCS	Programme Scoping
Transport	Programme Scoping
Built Environment	Programme Scoping
Heat	Programme Scoping
PV Solar	Not started
Industrial Processes	Not started
Large Scale Conversion	Not started
Bioenergy	Not started
Fuel Cells	Not started
Advanced Conversion	Not started

Key R&D Partnerships

EPSRC

Engineering and Physical Sciences Research Council

E.ON/EPSRC Strategic Partnership

- UK University based R&D

Themes:

- Low carbon energy systems
- Energy efficiency – customers behaviour
- Energy efficiency – technologies
- CCS – underpinning science

Funding:

- Total value £10M over 5 years
- 50:50 Partnership

Benefits:

- Independently peer reviewed
- Consortia contain best academics in UK at recognised centres of excellence

Creating value by leveraging investments through strategic partnerships

Summary & Conclusions

Global warming is an 'Inconvenient Truth'

There is no immediate 'silver bullet' solution to the control of CO_2 emissions from energy supply – a mixed portfolio is required

There is an Energy 'Trilemma' to be solved which also involves security of supply and cost

There is a looming capacity shortfall in the UK that will influence the technology mix

A switch to gas will not enable 2050 CO2 targets to be met and could compromise security of supply

Interruptible renewable energy will need support generation or the development of energy storage

Power generation using coal can be virtually emissions free, but there are residual uncertainties regarding cost and operational performance

Additional underpinning R&D is required, but there is a real need for commercial scale demonstrations to resolve these issues – Government support is vital in this respect

Universities provide an invaluable source of innovative ideas and are vital