Nuclear Power

Energy Materials Dragon's Den

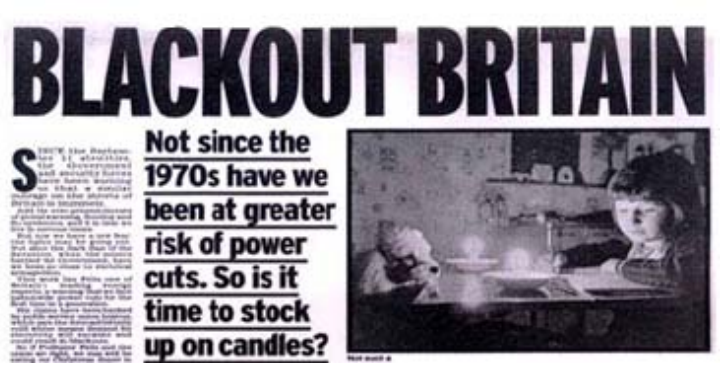
William Herbert
Samuel Humphry-Baker

Thanks to: Prof George Smith

OxfordMaterials

UK ENERGY LANDSCAPE

Energy Gap


BLACKOUT BRITAIN

Not since the 1970s have we been at greater risk of power cuts. So is it time to stock up on candles?

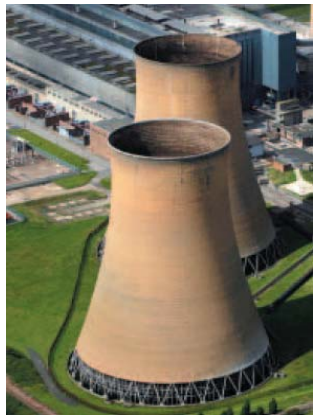
Climate Change

+

?

Nuclear Power

- ✓ Safe and affordable
- ✓ Baseload generation
- ✓ Security of supply
- ✓ CO_2 emissions lower than wind



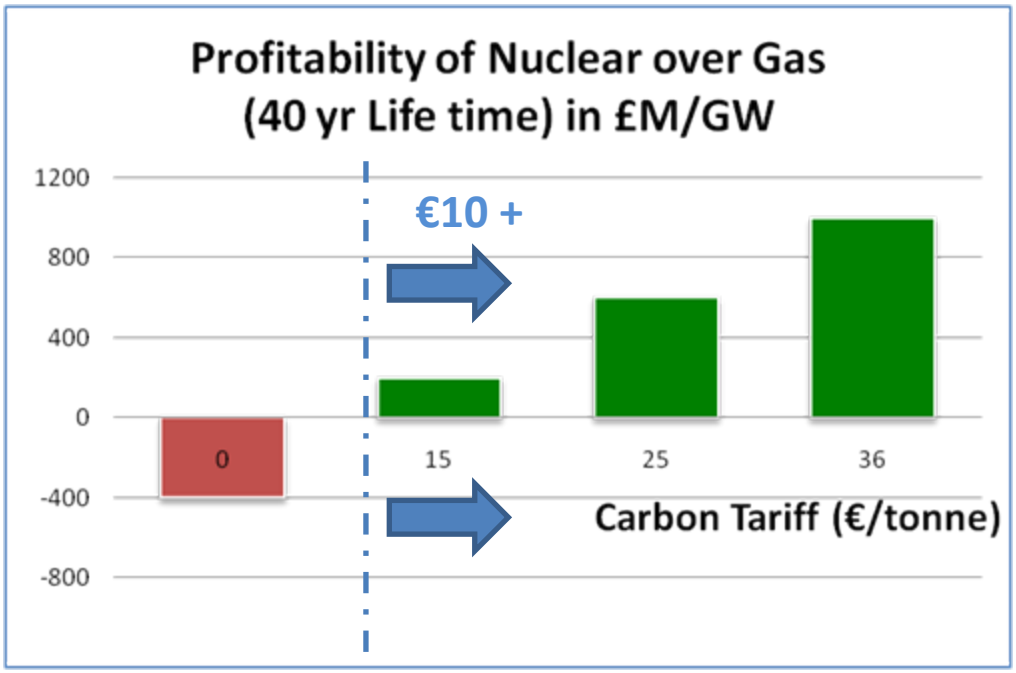
BASELOAD: "GO NUCLEAR"

GAS & RENEWABLES: Flexible Demand

1 Table data from RWE Investor relations presentation
Newspaper cut-out: Materials UK- Energy presentation

Pictures- Materials UK Energy review 2007 Report 1

PROFITABLITY



NEW BUILD EXAMPLE

- Nuclear: £2 billion per GW
- CCGT: £0.5 billion per GW

Gas price
(37p/therm)

April 08
CO_2 tariff
(€22/tonne)

Comparative welfare =
£480m/GW
(over 40 years)

- €15/tonne minimum on carbon tariffs would induce the private sector to invest in nuclear.

- Related companies, institutions and the economy as a whole stand to benefit.

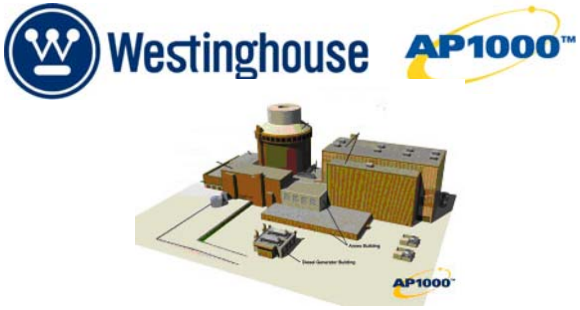
- The subsidies required are minimal compared to renewables like wind.

Sources: "The Energy Challenge – Energy review report 2006"; Ian Jackson- "Nukenomics "

"GLOBAL RENAISSANCE"

- Renewed support & investment for nuclear.
- **£650 bn** in new build PWRs and **£350 bn** in decomissioning [1].

New Build PWR



- No novel materials required
- Lifetime Prediction (60+ yrs):
  - Graphite irradiation
  - Fe-Cr embrittlement
  - Austenitic alloys SCC
- *In-situ,* non-destructive monitoring of degradation.
- Advanced modelling of materials ageing
- Play to traditional strengths of UK materials/metallurgy community

1. Manchester University report June 2009; image courtesy Areva.

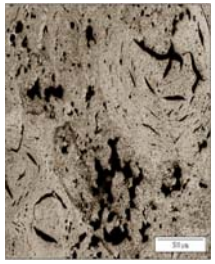
GEN IV: BEYOND 2020

How can the UK position itself as a world leader in emerging technologies for the latter part of the 21st Century?

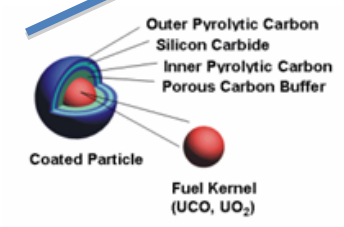
Playing to our Strengths

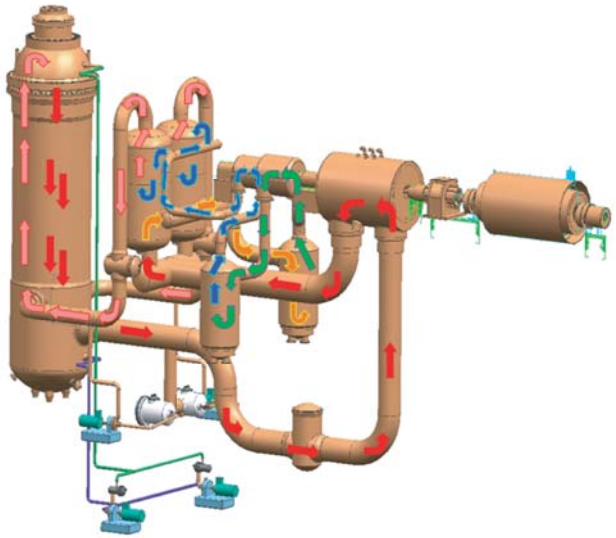
Gas Cooling (AGRs)

Graphite Irradiation



Ceramics Expertise





Pebble Bed Modular Reactor (200MW)

Business Opportunity

Export Technology
- Market Niche
- China

Decrease reliance on other countries
- Avoid becoming "passive customer"

Build on expertise

FUSION: BEYOND 2050

R&D projects from Fission hold strong synergies with Fusion technology, in which the UK is already world leader.

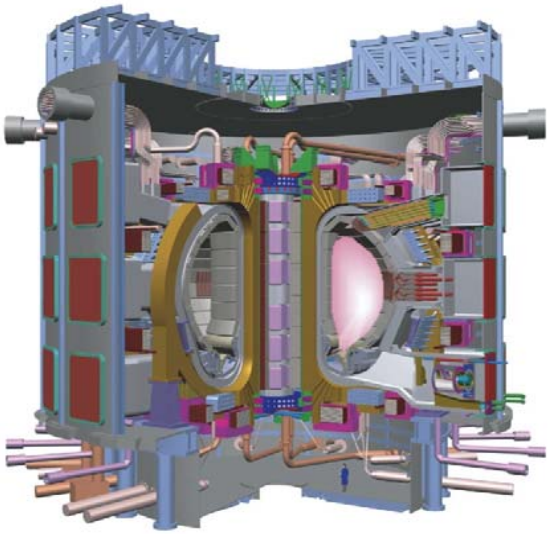
PROMOTING UK INNOVATION IN FUSION TECHNOLOGY

- Immense materials challenges
  - extreme temperatures
  - higher neutron energies
- Understanding complex irradiation/thermal degradation in bcc alloys.
- UK involved in ITER project

EPSRC

OxfordMaterials

£5.5 million grant proposal

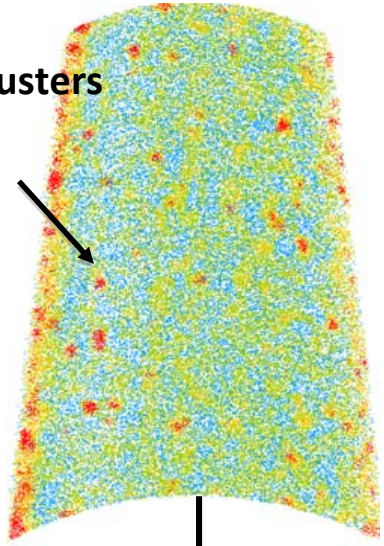


FUNDAMENTAL R&D

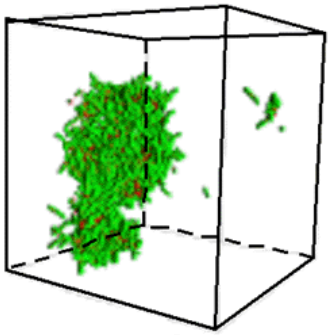
- ***Understanding degradation mechanisms from irradiation damage and high temperatures.***
- ***Non-destructive monitoring and predicting the in-service behaviour of components.***

Atomic Scale Structural Changes

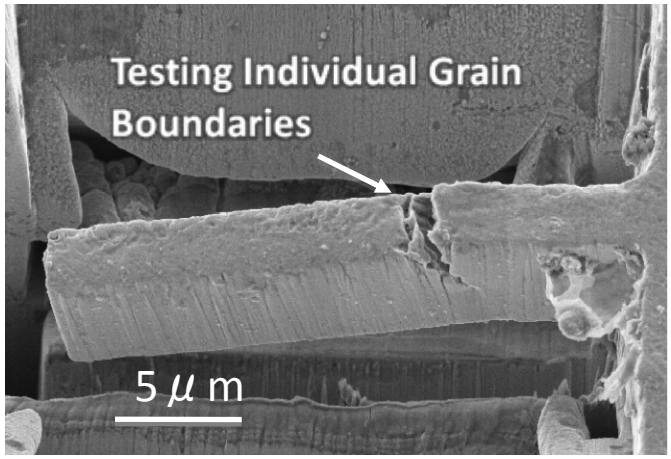
Nano-clusters in W-Re



Modelling

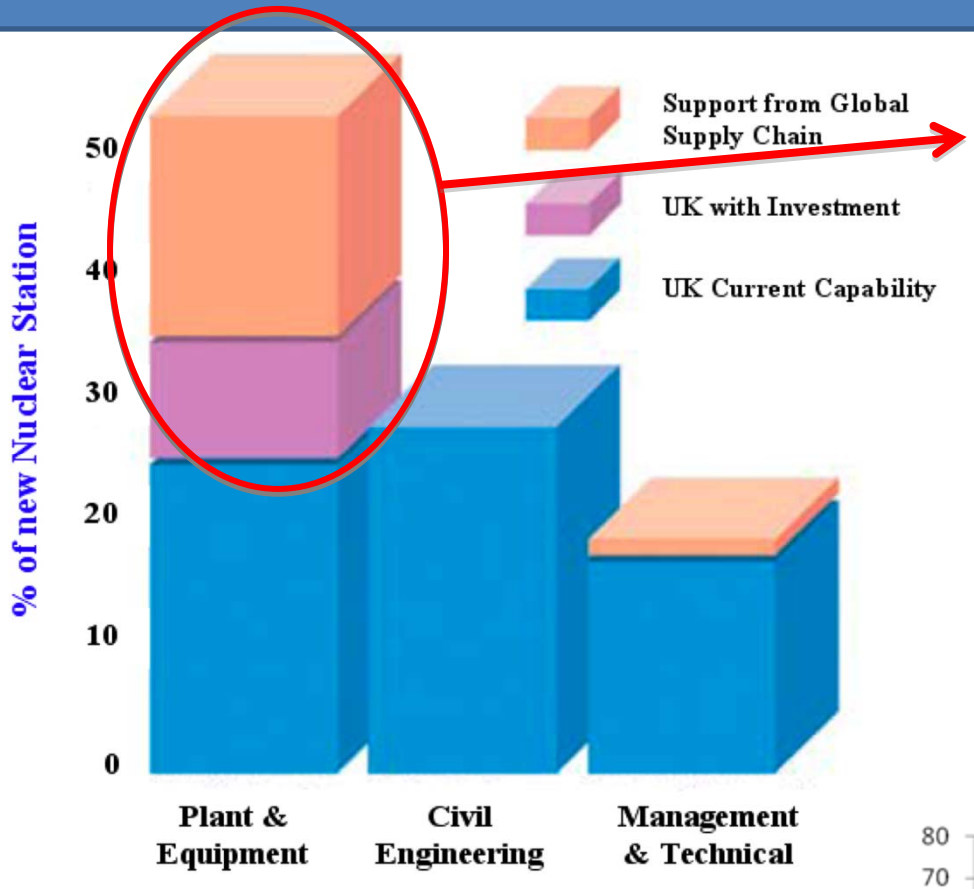


Mechanical Properties on the Microscale

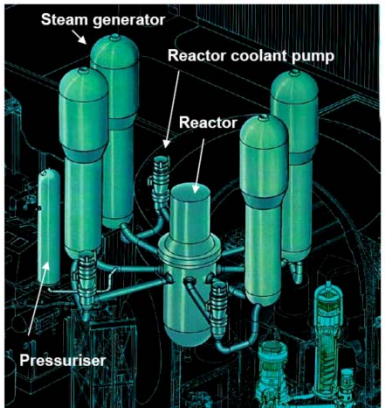


BETTER DESIGN OF ALLOYS

MATERIALS SUPPLY CHAIN



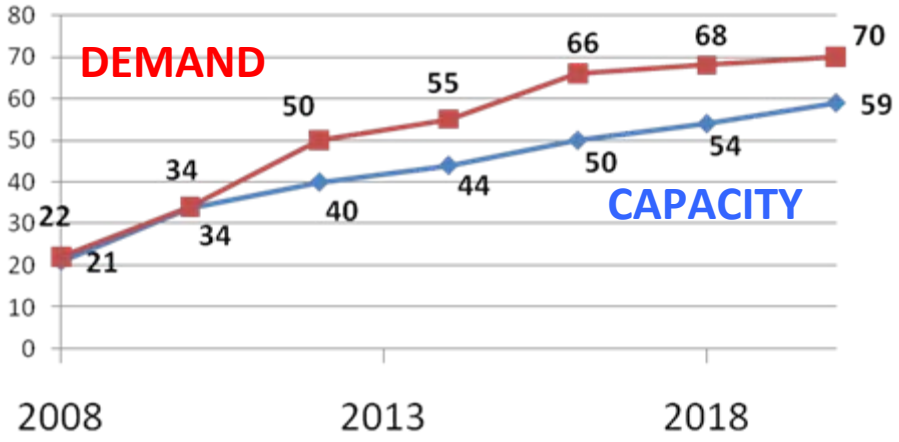
- **Very Large Forgings (360 tonnes +)**
- **Induction bending equipment**
  (1ry circuit pipework)
- **Seamless tubing (St. steels and Ni-alloys)**



Sheffield Forgemasters

- 15,000 tonne press by 2012
- Opportunity for investment (£100M +)
- All heavy equipment for EPR/AP1000

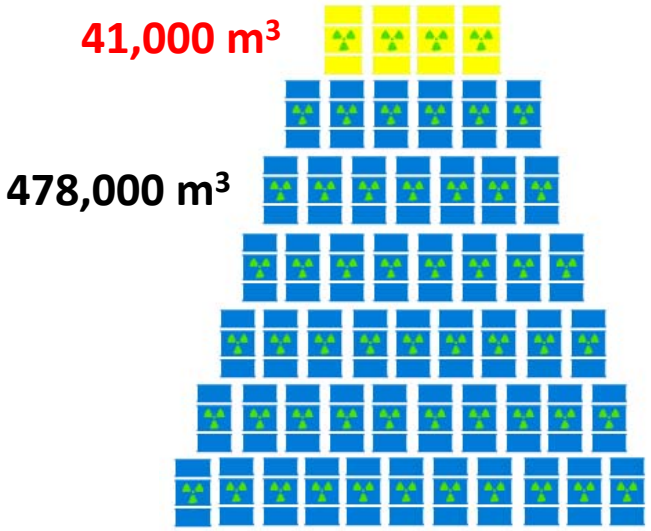
Heavy Nuclear Forgings in '000 Tonnes



Sources: Sheffield Forgemasters: "*The case for a 15,000 tonne open die forging press*"
Stephen Court: "*The mapping of materials supply chains in the UK's power generation sector*"

FUEL CYCLE & WASTE MANAGEMENT

- Unique expertise and facilities in fuel design
- "Strong" R&D capabilities in:
  - -Waste Treatment
  - - Decommissioning
  - - Reprocessing & Enrichment
- Huge opportunity for wealth creation



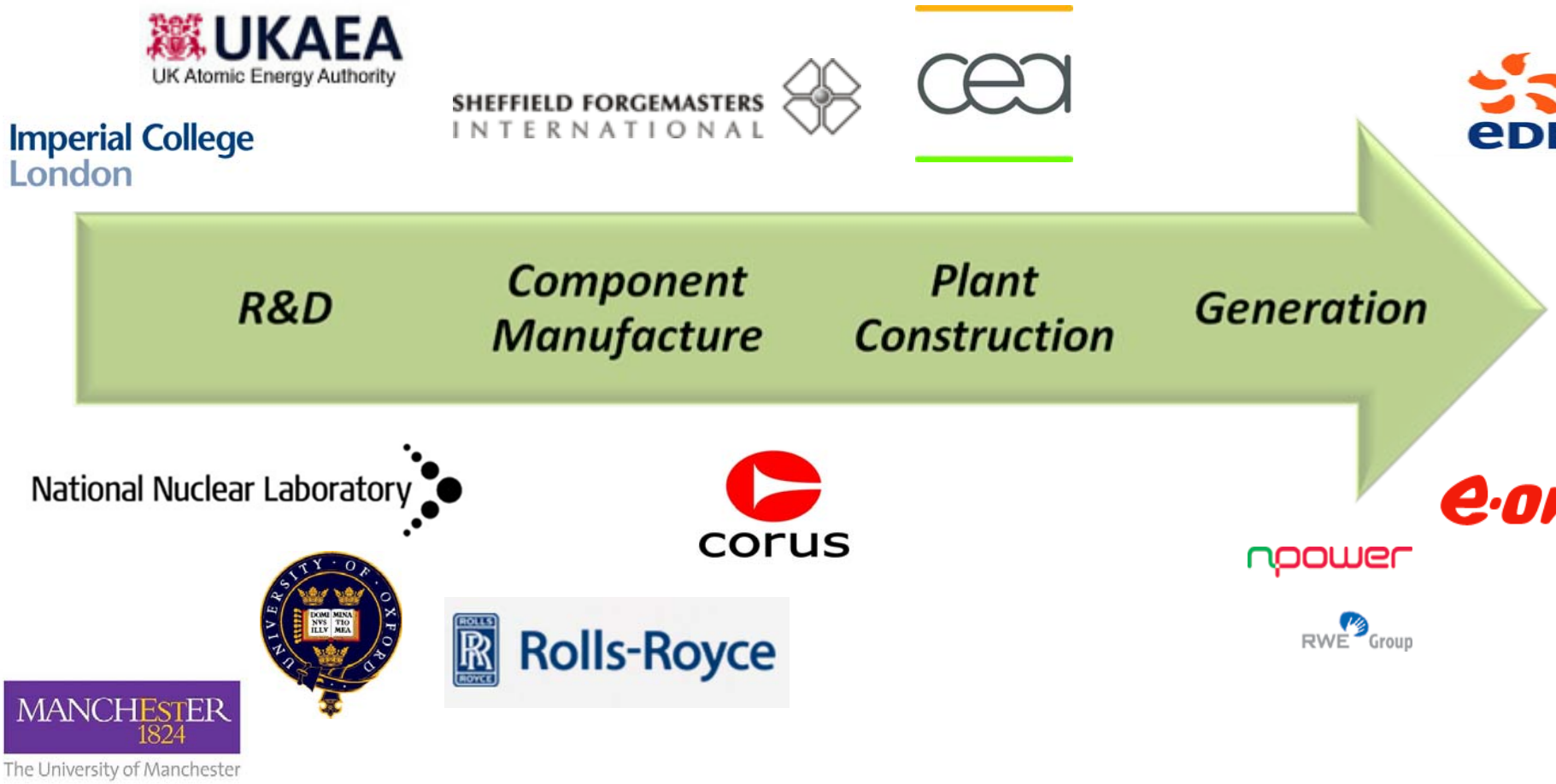
NDA proposed £10 bn investment in geological storage facility.

UK materials scientists can contribute to this flagship project.

1. University of Manchester report, June 2009; 2. Eurobarometer, European Commission, www.ec.europa.eu (Jan 2009)

GROSS VALUE ADDED

Many institutions and companies will play a role at each stage of the innovation chain, benefiting the UK materials community and the economy as a whole.



[5] House of Commons Innovation, Universities, Science & Skills Committee: "Engineering: turning ideas into reality", 4th Report 2008–09, Vol. I

JOB CREATION

UK " expected to need 1,000 new graduates a year for the next 15 years" [1]

Apprenticeships in Nuclear Energy

Training Contracts
£21,000 starting salary

EPSRC

EPSRC

Engineering and Physical Sciences Research Council

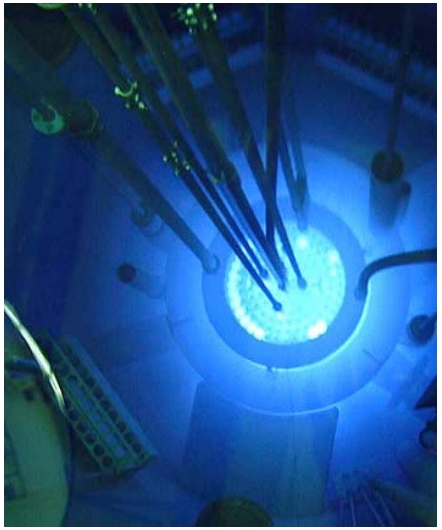
Undergraduate Scholarships in Nuclear Engineering

Choose a nu-clear career path!

Bursaries available to students in the physical sciences

Up to **£5000 pa**

Be a part of the future of UK energy!



[1]We need an expensive miracle, The Guardian, 18 Sep. 2008

AGENDA FOR ACTION

How can funding agencies improve the UK's strategic position in the global nuclear industry?

Action	What	How	Who
Advancing UK Nuclear materials expertise	Fundamental and applied R&D	Grants, Scholarships	EPSRC, TSB, RDA's
Assisting UK industry	Publicizing and investing in new business opportunities,	Supply Chain workshops, encouraging accreditation, investment in infrastructure	RDAs, TSB
Connecting Universities and Industry	Knowledge transfer	Encouraging two way secondments	RDAs, TSB

CONCLUSIONS

- Nuclear is a clear choice for a society that is serious about combating climate change.
- The UK has traditionally been a world leader in the technology and materials.
- Opportunity to re-vitalise a declining Nuclear industry.
- UK materials community in a perfect position to benefit from global resurgence.
- Positive action is needed urgently to ensure the UK maintains the infrastructure to be a world leader.