Nuclear Power

Energy Materials Dragon’s Den

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Thanks to: Prof George Smith
UK ENERGY LANDSCAPE

Energy Gap

Climate Change

Nuclear Power

- Safe and affordable
- Baseload generation
- Security of supply
- CO₂ emissions lower than wind

BASELOAD: “GO NUCLEAR”

GAS & RENEWABLES: Flexible Demand

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

Global warming. oh no.

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

Pictures- Materials UK Energy review 2007 Report 1
• €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.

"GLOBAL RENAISSANCE"

- Renewed support & investment for nuclear.
- £650 bn in new build PWRs and £350 bn in decommissioning.

**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

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

£5.5 million grant proposal

OxfordMaterials
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**

Testing Individual Grain Boundaries

**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

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.

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.

UK “expected to need 1,000 new graduates a year for the next 15 years”

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

**Apprenticeships in Nuclear Energy**

Training Contracts

£21,000 starting salary

**Undergraduate Scholarships in Nuclear Engineering**

Choose a nuclear career path!

Bursaries available to students in the physical sciences

Up to £5000 pa

Be a part of the future of UK energy!
How can funding agencies improve the UK’s strategic position in the global nuclear industry?

<table>
<thead>
<tr>
<th>Action</th>
<th>What</th>
<th>How</th>
<th>Who</th>
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<tbody>
<tr>
<td>Advancing UK Nuclear materials expertise</td>
<td>Fundamental and applied R&amp;D</td>
<td>Grants, Scholarships</td>
<td>EPSRC, TSB, RDA’s</td>
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<tr>
<td>Assisting UK industry</td>
<td>Publicizing and investing in new business opportunities,</td>
<td>Supply Chain workshops, encouraging accreditation, investment in infrastructure</td>
<td>RDAs, TSB</td>
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<tr>
<td>Connecting Universities and Industry</td>
<td>Knowledge transfer</td>
<td>Encouraging two way secondments</td>
<td>RDAs, TSB</td>
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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.